

Consumption Functions and Probabilities of Consumption Expenditures by U. S. Farm Operators, 1961

CHAN CONNOLLY

TED L. JONES

OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER
WOOSTER, OHIO

CONTENTS

* * * * *

Foreword.....	3
Introduction.....	3
Objectives.....	3
Theory.....	3
The Consumption Function.....	4
Mathematical and Graphic Structure of the Model.....	4
Empirical Work Related to Consumption Functions.....	4
Empirical Parameter Estimates for Consumption Functions.....	6
Methodology.....	6
Conceptualized Models for U. S. Agricultural Sector.....	6
Assumptions.....	6
Structure of the Models.....	6
Probability Estimates.....	9
Collection and Analysis of Data.....	10
Collection of Data.....	10
1960-61 Consumer Expenditure Survey.....	10
Data Sources and Collection Methods.....	10
Sample Size.....	10
Sample Design.....	11
Tabulation of Data.....	11
Weighting of Data.....	11
Evaluating Data.....	12
Definition of Terms.....	12
Analysis of Data.....	13
Aggregation of Data.....	14
The Finite Universe—Rural Farm Population.....	14
Macro Analysis.....	15
Segmented Model.....	18
Probability Model.....	20
Probabilities of Annual Consumption Expenditures.....	22
Summary and Conclusions.....	24
Summary.....	24
Conclusions.....	25
Bibliography.....	25
Appendix.....	26

ACKNOWLEDGMENTS

The authors express their appreciation to The Ohio State University Computer Center for computer time and program assistance; to Mr. Tom Lanahan, Bureau of Labor Statistics, Washington, D.C., for permission to use a portion of the data from the 1960-61 Consumer Expenditure and Income Survey; to Miss Jean L. Pennock, Chief, Family Economics Branch, Agricultural Research Service, U. S. Dept. of Agriculture, for assistance in the interpretation of parts of the survey data; and to Mrs. Elizabeth Howard and associates in the Statistical Laboratory, Department of Agricultural Economics and Rural Sociology, The Ohio State University, for statistical services. Special thanks are extended to Drs. Ralph W. Sherman, Edgar T. Shaudys, and Howard L. Steele, Department of Agricultural Economics and Rural Sociology, for reviewing the manuscript and offering useful suggestions, and to Mrs. Linda Wright and Miss Connie LePage for typing the manuscript.

Consumption Functions and Probabilities of Consumption Expenditures by U. S Farm Operators, 1961

CHAN CONNOLLY and TED L. JONES

FOREWORD

To acquire additional knowledge about the average farm operator's family consumption expenditures and the variance among farm families within the contemporary U. S. agricultural sector, one necessary condition is to quantify numerical data concerning consumption expenditure behavior. Within this context, the purpose of this inquiry was (1) to quantify the functional relationship of disposable income and consumption expenditures for farm operator families within the contemporary U. S. agricultural sector; (2) to estimate aggregate consumption expenditures and disposable income within the contemporary U. S. agricultural sector; and (3) to quantify the probability of an individual farm operator's aggregate annual consumption expenditures.

This publication was written primarily for use by academicians and researchers in agricultural finance.

INTRODUCTION

Lenders of agricultural credit typically estimate an individual farm operator's disposable income from all sources by subtracting estimated operating expenses plus depreciation and federal-state taxes from the farm operator's gross income. The residual, normally referred to as disposable income, is available for family living expenses and savings. However, the farm operator's family has first claim on disposable income for subsistence living.

Economically viable farm operators typically have a positive balance of income after subsistence living is deducted. This balance, often referred to as discretionary income, may either be used for additional consumption expenditures, for savings or for a combination of consumption and savings. Traditionally it has been extremely difficult for lenders of agricultural credit to estimate consumption expenditures for an individual farm operator's family due to the great variance among farm families in discretionary consumption expenditures. In addition, there are numerous consumption expenditure components within each family's budget, with many small expenditures made throughout the year, making total consumption expenditures difficult to estimate.

For these reasons, lenders of agricultural credit typically use an average consumption expenditure for an estimate of consumption expenditure for an individual farm operator's family. However, there is a great dispersion of consumption expenditures among farm operators' families due to the variation in discretionary consumption expenditures. Therefore, the average consumption expenditure estimate used for an individual farm operator's family lacks reliability.

The primary purpose of this study is to quantify consumption expenditures for farm operators' families and to develop criteria for estimating the probability of an individual farm operator's consumption expenditures which are consistent, unbiased, and efficient.

OBJECTIVES

The objectives of this study were:

- To quantify the average consumption behavior of contemporary U. S. farm operators for a short run period.
- To estimate the aggregate consumption and aggregate disposable income for the U. S. agricultural sector for a short run period.
- To estimate the probability of different levels of annual consumption expenditures for individual farm operators by disposable income levels.
- To estimate the average propensity to consume, marginal propensity to consume, income elasticities for consumption, and the multiplier for the U. S. agricultural sector.

THEORY

The relation between aggregate income and aggregate consumption, typically referred to as the consumption function, has played a major role in economic thinking since the publication of *The General Theory of Employment, Interest, and Money* by John Maynard Keynes in 1936. Keynes asserted that current consumption expenditure is a highly dependable and stable function of current income and that the amount of aggregate consumption mainly depends on the amount of aggregate income. Keynes measured both aggregate income and aggregate consumption in terms of wage units. He stated that it is a fundamental psychological rule of any modern com-

munity that, when its real income is increased, it will not increase its consumption by an equal absolute amount and a greater proportion of the real income is saved as real income increases (4).

With this theoretical structure, the consumption expenditure is expressed as a function to income. Although income, measured as disposable income, is not the only determinant of consumption, it is the major determinant.¹

The Consumption Function

Consumption as a function of disposable income is based on the following three hypotheses about the nature of the relationship (6):

1. The greater disposable income, the greater aggregate consumption.
2. For some low levels of income, consumption will exceed disposable income; i.e., households or spending units in the aggregate will be going into debt or using up part of their savings. Beyond some level of income, however, not all of the income received by households will be spent on consumption.
3. Any given rise in income will cause a less than proportionate rise in consumption.

Mathematical and Graphic Structure of the Model

Current income is equal to the sum of all claims to current production, when the latter consists of consumption and savings, expressed mathematically as:

$$Y \equiv C + S \quad (1)^2$$

when:

Y = disposable current income

C = current consumption

S = current savings

For the linear relationship between consumption and income:

$$C = \alpha_c + b_1 Y \quad (2)$$

when:

C = current consumption

α_c = a constant representing level of consumption function

b_1 = a constant representing slope of consumption function

Y = disposable current income

Equation (1) is an accounting expression and equation (2) is a behavioral relationship.

When the model is in equilibrium, savings equal investment expressed as:

$$S = I \quad (3)$$

where:

S = savings

I = investment

¹Keynes' theoretical structure was based on the previous work of Ernest Engel in Belgium in 1895. Engel's income-food expenditure curve is now referred to as "Engel's Law." Engel's work showed that high-income groups spent more money per capita for food than low-income groups; however, the high-income groups spent a smaller proportion of their income for food than the low-income group.

²The symbol \equiv represents an identity equation with no parameters.

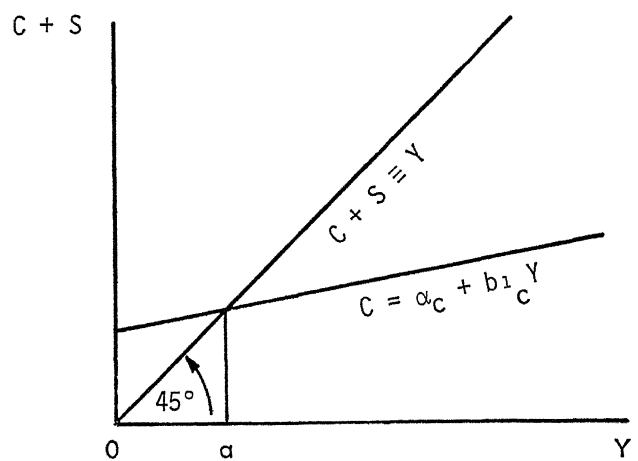


Fig. 1.—Simplified Keynesian Model.

Figure 1 presents the mathematical relationships of equations (1), (2), and (3).

At low levels of income, consumption exceeds income. At income level Oa in Fig. 1, consumption equals income. At this point, zero savings are generated. Below this point, negative savings occur. As income rises above level Oa , the consumption function lies below the 45° line, indicating that an increase in income results in an increase in consumption expenditure which is smaller than the increase in income.

The average propensity to consume (APC) is the proportion of total income spent on consumption. APC is a ratio of total consumption to total income.³

The marginal propensity to consume (MPC) measures the relation between changes in consumption and changes in income. MPC is a ratio of change in consumption to change in income.⁴

Empirical Work Related to Consumption Functions

Keynes' theoretical structure stimulated interest in empirical work. Subsequently, consumption functions were estimated from two kinds of data: first, time series using consumption observations on income, and second, budget data observations which were made available from numerous sample surveys made during the past century and a half (9, 11).

These data confirmed Keynes' hypotheses that current consumption expenditure was highly correlated with income, marginal propensity to consume was less than unity, and marginal propensity was less than the average propensity to consume, resulting in

$$\text{In symbols, } APC = \frac{C}{Y}$$

$$\text{In symbols, } MPC = \frac{\Delta C}{\Delta Y}$$

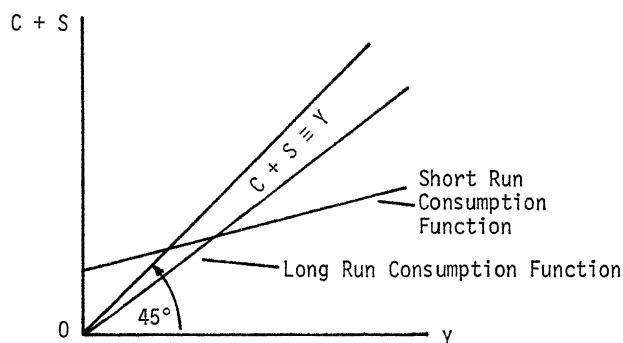


Fig. 2.—Short and Long Run Consumption Functions.

an increased percentage of income saved as income increased (3).

In 1952, Kuznets published evidence which revealed in his long run time series study of the U. S. economy, starting in 1897, that there was no rise in percentage of income saved in the U. S. during half a century despite a substantial rise in real income. Estimates from the Kuznets' study revealed that the percentage of income saved over this long run time period was virtually a constant and that the average and marginal propensities to consume were equal to each other (5).

After World War II, additional evidence revealed that the savings ratio was sharply lower immediately following the war than the ratio which was consistent with findings on the relationship between income and savings in the inter-war period. However, these findings were not inconsistent with the General Theory as Keynes asserted that the consumption function was virtually constant when economic conditions were not abnormal.

Empirical findings indicated that a single consumption function relating consumption or savings solely to income was inadequate. Parameter estimates of the consumption function vary according to the length of time period under study. Long run consumption functions, with a length of time period covering decade to decade, revealed a close relationship between consumption and income. Average and marginal propensities to consume are less than unity, average propensity to consume does not decline as income rises, and average and marginal propensities to consume are virtually equal.

Short run consumption functions covering a time period of 1 year also reveal a close relation between consumption and income. Average and marginal propensities to consume are less than unity but the average propensity to consume declines as income rises. The relation between average and marginal propensities to consume is also different. In the short run, APC is greater than MPC.

The very short run consumption function, where length of time period is less than 1 year, revealed that the relationship between consumption and income is not as close as in the long and short run time periods.

As very short run consumption expenditures are not highly correlated with very short time period incomes, empirical work was stimulated which focused on an explanation to this question. Findings revealed that much of the variability in very short run consumption expenditures was in the durable category. Purchase of durable goods responds to interest rates, size of down payment, and expected changes in income. These variables seem to be more important than income in explaining the purchase of durables (11).

It is thus more meaningful to think not of the consumption function but of one function suitable for decade-to-decade variation in income, of another suitable for year-to-year changes, and of yet another suitable for less than a year variations in income. The long and short run consumption functions are presented in Figure 2. No attempt is made to present the very short run consumption function due to its instability (11).

Many economists have advanced theories to explain the difference in parameters of consumption functions as related to variance in length of time periods. Attempts were made to improve the absolute income hypothesis, a relationship between increased consumption and income; subsequently, many modified consumption functions were suggested.

The latter income hypotheses, as a group, are referred to as the relative income hypotheses (3). The basis for these hypotheses is the way in which income is measured. Relative income hypotheses assert that the ratio of consumption to income for a householder or spending unit depends on the relative income position of the unit measured by either a ratio of its income to the mean income of its group or its percentile position in income distribution (2). The aggregate measurement for consumption in the relative income hypotheses depends not only on current aggregate income but also on the previous income. Duesenberry explains the long run consumption functions by the "ratcheting effect" of short run consumption functions (2).

One of the most plausible consumption income hypotheses, although with criticism, has been advanced by Friedman (3). In attempting to arrive at the fundamental character of the relationship between consumption and income, Friedman advanced what has come to be called the "permanent income hypothesis." Friedman's theory is one of proportionality and provides an explanation for the long time equality between APC and MPC. Friedman's

theory is that income of an individual can be divided into permanent and transitory components. The individual's permanent income component is the income he reasonably expects to receive over a period of several years, while the transitory component consists of unexpected or unforeseen additions or subtractions to his income. Over the long run, such additions and subtractions tend to cancel out. Given these components, Friedman's basic hypothesis is that permanent consumption is proportional to permanent income. Savings increase or decrease whenever there is an increase or decrease in the transitory component of income. This hypothesis provides an explanation for such short run fluctuations in the saving-income or consumption-income ratio as are found in the short run periods. Over the long run, consumption will rise in proportion to change in the permanent component of the individual income.

Empirical Parameter Estimates for Consumption Functions

Considerable empirical work has been done to obtain estimates for the parameters of consumption functions in the U. S. and other countries. A range of values for the parameters has been estimated and differences are due primarily to definitions of income and consumption, time period, structure of consumption function, level of income group sampled, source of income, and variability of income. Savings in the U. S. have virtually been a constant fraction of income over time and computed consumption regressions have steadily been higher, the later the budget study (3).

Empirical findings for the long time period reveal that the ratio of aggregate consumption to aggregate income for the U. S. has remained roughly a constant for more than half a century at about .88 for a definition of consumption which excludes expenditures on major consumer durable goods and includes their estimated use value (3). Accumulation of durables has accounted for an increasing fraction for savings. So the ratio of consumption to income would be slightly higher and would show a moderately rising secular trend for measures of consumption which treated expenditures on durables as consumption. These conclusions are supported by both budget and time series data (3).

Using Friedman's permanent income hypothesis, with a horizon of about 3 years, the ratio of permanent consumption to permanent income has been estimated from .90 to .95 for wage earners, from .80 to .90 for entrepreneurs, and from .85 to .90 for farmers (3).

The differences among the several studies in the U. S. (Appendix Table I) are minor, however, com-

pared to the remarkably consistent differences between farm and non-farm families. Consumption expenditures of farm families are lower at any absolute income level except, perhaps, at the lowest levels of income observed in the farm samples; increase less rapidly with measured income with both marginal propensity to consume and the income elasticity of consumption expenditures decidedly lower; and are on the average a smaller fraction of average income, but this difference is much smaller for the comparison in terms of money items alone. In all cases, however, it is in the same direction (1, 3, 7, 8).

METHODOLOGY

Conceptualized Models for U. S. Agricultural Sector

Two short run economic models representing the U. S. agricultural sector were employed to quantify and measure consumption expenditures with a probability measure for consumption by an individual farm family. One model was employed for aggregate measurements and is referred to as the macro model; the other model was employed for classes of farm operators stratified by disposable income levels and is referred to as the segmented model.

Assumptions

The assumptions for the macro and the segmented statistical models were as follows:

1. Constant price level.
2. Consumption is a linear function of disposable income.
3. Agricultural income measurement used in the macro model is disposable income derived from domestic and foreign sales, government subsidies, and non-farm income generated by the aggregate farm operators.
4. Agricultural income measurement used in the segmented model is disposable income derived from farm net income and non-farm income for each stratified income group of farm operators.⁵
5. Savings equal investments with all forces in equilibrium in the macro model and in each segment of the segmented model.
6. Consumption by farm operators is relatively stable.

Structure of the Models

The structure of both the macro and the segmented models is basically Keynesian. Each model is static and contains a simplified set of relationships for the U. S. agricultural sector.

Consumption function for the average farm operator. To derive the macro consumption function,

⁵Agricultural income measurements for the macro and the segmented models are consistent. The segmented income measurements are mutually exclusive and totally exhaustive. The sum of all segmented income measurements is equal to the macro income measurement.

the parameter estimates for the consumption function for the average U. S. farm operator were first estimated by utilizing the following statistical model.

Average Farm Operator Consumption Function Statistical Model

$$\bar{C} = b_0 + b_1 Y + u \quad (4)$$

where:

\bar{C} = Consumption function for the average U. S. farm operator
 b_0 = Level of the consumption function for the average U. S. farm operator

b_1 = Slope of the consumption function for the average U. S. farm operator
 Y = Disposable income
 u = Statistical error term

The level of the aggregate consumption function for U. S. farm operators, α_c , was derived by multiplying the level of the grand average farm operator's consumption function:

$$b_0$$

by the number of farm operators in the universe. Aggregate disposable income likewise was derived by multiplying the average U. S. farm operator's disposable income level by the number of farm opera-

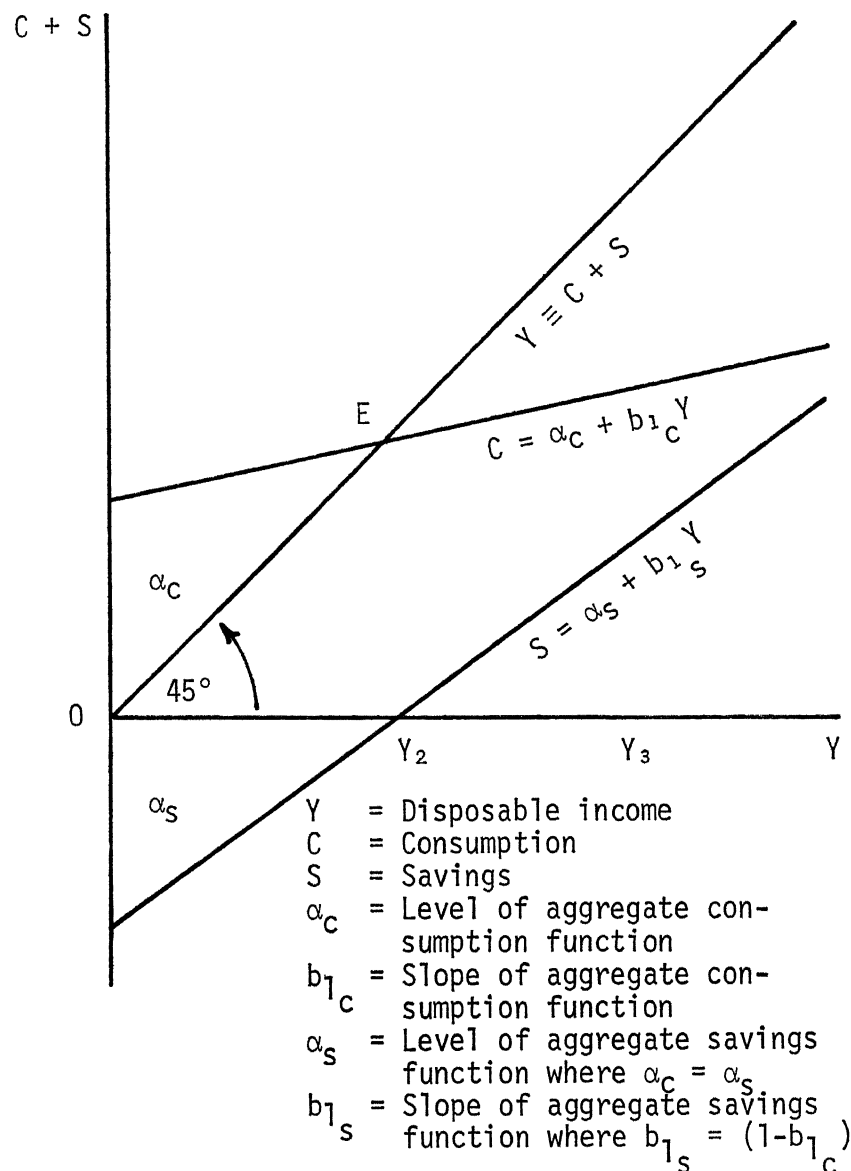


Fig. 3.—Hypothetical Structure of a Short Run Aggregate Consumption Function and a Saving Function for U. S. Agricultural Sector,

tors in the universe. The marginal propensity to consume (MPC), estimated parameters in the average consumption function, were identical to the parameters in the aggregate consumption function.

Macro model. A simplified macro model of the U. S. agricultural sector is presented in Figure 3. The ordinate (C+S) measures levels of the aggregate consumption expenditures plus savings. The abscissa (Y) measures aggregate disposable income, which is the sum of net aggregate farm income and non-farm income less taxes. The 45° linear line is an accounting identity relating aggregate disposable income to consumption and savings. With the model in static equilibrium, aggregate disposable income equals aggregate consumption plus aggregate savings. The mathematical relationship is expressed as follows:

$$Y \equiv C + S \quad (1)$$

where:

Y = Aggregate disposable income for U. S. agricultural sector

C = Aggregate consumption expenditures for U. S. agricultural sector

S = Aggregate savings for U. S. agricultural sector

The aggregate consumption function is based on the proposition that as the aggregate disposable income rises, the aggregate absolute amount spent for consumption increases but the percentage of the aggregate disposable income spent for consumption declines. The aggregate consumption function is a behavioral economic relationship of all farm operator families in relation to different aggregate levels of disposable income and is expressed in the following model:

$$C = \alpha_c + b_1 Y \quad (2)$$

where:

C = Aggregate consumption expenditures for the U. S. agricultural sector

α_c = Level of aggregate consumption expenditures for the U. S. agricultural sector

b_1 = Slope of aggregate consumption function, which is the marginal propensity to consume

The aggregate consumption function is presented in Figure 3. The equilibrium point E represents the aggregate income level just equal to aggregate consumption. Mathematically this point is expressed as: $Y = C$.

Conceptually, aggregate savings in the U. S. agricultural sector may now be measured. Given the aggregate consumption function, aggregate income less than Y_2 represents dissavings, the magnitude of which is represented by the vertical distance between the 45° line and the consumption function line. No savings occur at aggregate income Y_2 as aggregate consumption and aggregate income are exactly equal.

With aggregate income greater than Y_2 , savings are generated, the magnitude of which is measured by the vertical distance between the 45° line and the aggregate consumption function line.

The aggregate savings function is also represented in Figure 3. With aggregate income less than Y_2 , dissavings occur; with aggregate income equal to Y_2 , no savings or dissavings occur; with aggregate income greater than Y_2 , aggregate savings are generated. Using empirical measurements, this model provides the framework to measure the magnitude of aggregate savings generated in the U. S. agricultural sector for a short run period. Savings generated by appreciation of real estate owned are not included.

Segmented model. A simplified consumption segmented model of the U. S. agricultural sector was constructed with the ordinate measuring levels of consumption expenditures and savings for the average U. S. farm operator in each of ten income groups. All farm operators were stratified into one of ten disposable income groups, with each income group being mutually exclusive and totally exhaustive. The total disposable income for the agricultural sector is equal to the total of all disposable income groups. The abscissa (Y) represents the disposable income classes for each of the ten income groups.

Test criterion. The greater coefficient of determination was used for selecting either the aggregate consumption or the segmented consumption model for estimating probability of annual consumption expenditures for an individual farm operator's family. The interaction model was utilized to estimate the coefficient of determination and the added contribution of levels and slopes in the segmented model to the coefficient of determination. The levels and slopes for the consumption and saving functions in the segmented model were allowed to vary to test for interaction.

The statistical model for this test was:

$$C = b_0 + \sum_{i=1}^9 d_i D_i + (b_1 + \sum_{i=1}^9 c_i D_i) Y + u$$

$$= b_0 + \sum_{i=1}^9 d_i D_i + b_1 Y + \sum_{i=1}^9 c_i (D_i Y) + u \quad (5)$$

$$D_i \begin{cases} +1 & \text{if income group } i \\ 0 & \text{if not income group } i \text{ or } 10 \\ -1 & \text{if income group } 10 \end{cases}$$

where:

C = Consumption for average U. S. farm operator

b_0 = Level of consumption function for average U. S. farm operator

b_1 = Slope of consumption function for average U. S. farm operator

Y = Disposable income

d_i = Regression coefficient for dummy variable D_i
 c_i = Regression coefficient for product of dummy variable and disposable income
 D_i = Dummy variable for income stratum i
 u = Statistical error term

To avoid singularity, the model is restricted to nine dummy variables. With any combination of nine dummy variables all known, the tenth dummy is uniquely determined by the use of the following formulas:

$$\sum_{i=1}^9 d_i = -d_{10}$$

$$\sum_{i=1}^9 c_i = -c_{10}$$

The following hypotheses were tested.

Two multiple hypotheses⁶ were used: first, to determine the contribution of slopes (MPC's) to total R^2 by making a priori restriction,

$$\sum_{i=1}^9 c_i (D_i Y) = 0$$

and second, to determine the contribution of the consumption function levels by making a priori restriction,

$$\sum_{i=1}^9 d_i D_i = 0.$$

Multiple Hypotheses—a priori restriction

$$1. \sum_{i=1}^9 c_i (D_i Y) = 0$$

Statistical model was as follows:

$$C = b_0 + \sum_{i=1}^9 d_i D_i + b_1 Y + u \quad (6)$$

$$D_i \begin{cases} +1 & \text{if in income stratum } i \\ 0 & \text{if not in income stratum } i \text{ or } 10 \\ -1 & \text{if in income stratum } 10 \end{cases}$$

The following hypothesis was tested:

No. 1 $H_0: R^2 = 0$

$$2. \sum_{i=1}^9 d_i D_i = 0$$

Statistical model was as follows:

$$C = b_0 + b_1 Y + \sum_{i=1}^9 c_i (D_i Y) + u \quad (7)$$

$$D_i \begin{cases} +1 & \text{if in income stratum } i \\ 0 & \text{if not in income stratum } i \text{ or } 10 \\ -1 & \text{if in income stratum } 10 \end{cases}$$

The following hypothesis was tested:

No. 1 $H_0: R^2 = 0$

Probability Estimates

The outcome of these statistical tests determined if the function for the income strata was significantly different from the average level and the average slope. If there was no significant difference, then the standard error of forecast for the consumption function for the average U. S. farm operator in the macro model was used to compute the standard deviation for the consumption probability distribution for each discrete disposable income value. However, if there was a significant difference, then a standard error of forecast was estimated within each income stratum for the average consumption function for each discrete disposable income value.

An estimate for the standard error of forecast for an individual consumption value was calculated by the following formula:

$$\hat{S}_F = C_{e.Y} \sqrt{1 + \frac{1}{n} + \frac{(Y_0 - \bar{Y})^2}{\sum Y^2}} \quad (8)$$

where:

\hat{S}_F = Estimated standard error of forecast of an individual saving variable, given a disposable income value, Y_0

$C_{e.Y}$ = Standard error of estimate

n = Size of sample

Y_0 = A given disposable income value

\bar{Y} = Mean disposable income

$\sum Y^2$ = Total variation of the Y values

The standard error of forecast is a variable as its value depends upon the distance of the individual Y_0 value from the mean. Consequently, a separate standard error of forecast was estimated for each given disposable income value.

The segmented model required the estimation of consumption function parameters for each income stratum, using the following statistical model.

$$\bar{C}_i = b_{0_{e_i}} + b_{1_{e_i}} Y + u \quad (9)$$

where:

\bar{C}_i = Average consumption value for a given disposable income in stratum i

$b_{0_{e_i}}$ = Level of consumption function in stratum i

$b_{1_{e_i}}$ = Slope (MPC) of consumption function in stratum i

Y_{0_i} = Disposable income value in stratum i

u = Statistical error term

The following four statistics were then available for stratum i , which was used for estimating the standard error of forecast:

⁶"Multiple hypotheses" is terminology unique to the MR-90 program and is synonymous with "a priori restrictions."

\bar{Y}_i = Mean disposable income for stratum i
 n_i = Sample size for stratum i
 $\sum y^2$ = Total income variation in stratum i
 $C_{e,y}$ = Standard error of estimate for the regression consumption on disposable income

The standard error of the individual consumption mean. The average consumption mean for a given disposable income value,

$$\bar{C}/Y_0$$

was computed by using the estimated parameters in the consumption function. The standard error of forecast for a given disposable income value was equivalent to the standard error of the consumption mean distribution. The probability of a consumption value for a given disposable income value was estimated by the following formula:

$$P \left[C > \bar{C}/Y_0 - \hat{Z}S_F \right] \quad (10)$$

where:

P = Probability

Z = Normal deviate

C = Individual consumption variable

\bar{C}/Y_0 = Mean consumption value for the given disposable income value, Y_0

\hat{S}_F = Estimated standard error of forecast for the given disposable income value, Y_0

The probability for a given consumption value for an individual farm operator with a given disposable income value, Y_0 , was estimated by use of the table of probability values under the normal density function.

A probability table for annual consumption expenditures from \$1,000 to \$20,000 with disposable income values from \$1,500 to \$22,600 was developed.

Use of the methodology as presented provided the necessary information for the objectives presented on page 3.

COLLECTION AND ANALYSIS OF DATA

Collection of Data

Seven nationwide consumer expenditure surveys (CES) in the U. S. have been conducted by the Federal government since 1888-91. The first nationwide expenditure survey was primarily a study of living costs with reference to competition in foreign trade. It emphasized the worker's role as a producer rather than as a consumer. Due to rising prices, a second survey was conducted in 1901. The third major survey, for the period 1917-19, provided weights for computing a "cost of living" index, now known as the Consumer Price Index (CPI). The fourth major study, 1934-36, was made primarily to revise the index weights and covered only urban wages and clerical workers.

However, during the severe economic depression of the 1930's, interest in consumer surveys expanded to all segments of the population, both urban and rural. Thus, almost simultaneously with the 1934-36 survey, the fifth 1935-36 study was conducted. In 1950, the sixth major survey was conducted. It covered only urban consumers and provided the basis for revising the CPI. The seventh and final survey, for the period 1960-61, measured the latest changes in consumption habits of the American people, both urban and rural.

1960-61 Consumer Expenditure Survey

The basic purpose of the 1960-61 consumer expenditure survey was to revise the CPI. In addition to this basic need, there were secondary needs for income and expenditure data for other purposes. The U. S. Bureau of Labor Statistics (BLS) is primarily responsible for all Consumer Expenditure and Income Surveys (CEIS). Since the 1960-61 CEIS was extended to rural areas, the U. S. Department of Agriculture (USDA) cooperated in the rural component of the survey.

Data Sources and Collection Methods

All data were collected by personal interview. The BLS was responsible for collecting data from all residents in urban areas. The BLS and USDA shared this responsibility in the rural areas of Standard Metropolitan Statistical Areas (SMSA's) and the USDA had sole responsibility for interviewing rural households in non-metropolitan areas. This divided the total survey into three components: urban, rural non-farm, and rural farm.

Sample Size

The master sample for the total urban and rural population included 17,283 residence addresses, which were assigned to interviewers (Table 1). Usable schedules tabulated were 13,728 consumer units, approximately 79 percent of the total. The rural farm component was assigned 2,581 schedules from which 1,967 or about 76 percent were usable.

The 1,967 usable schedules representing the rural farm sample were classified into three sub-components: 1,306 self-employed farm operators, 489 nonself-employed farm operators, and 172 nonself-employed non-farm operators. Self-employed farm operators represented about 66 percent of the sample, nonself-employed farm operators about 25 percent, and nonself-employed non-farm operators about 9 percent.⁷

⁷Farmers who spend more than 50 percent of their time farming were considered as self-employed farm operators. Those who spend less than 50 percent of their time farming were classified as nonself-employed farm operators, often referred to as part-time farmers. Those farm families who were nonself-employed non-farm operators consisted of farm laborers, retired, and unemployed.

TABLE 1.—Number of Schedules Assigned Addresses, Usable Schedules, and Percent Usable Schedules by Survey Components, 1960-61 U.S. Consumer Expenditure and Income Survey.

Survey Component	Assignment Addresses	Usable Schedules	Percent Usable Schedules
Total Urban and Rural	17,283	13,728	79.4
Rural Farm	2,581	1,967	76.2
Rural Non-farm	2,497	2,285	91.5
Urban	12,205	9,476	77.6

Source: U. S. Bureau of Labor Statistics, Handbook of Methods for Surveys and Studies, Bull. 1458, p. 57.

Sample Design

Farm households in the rural United States were selected for interviews on the basis of a stratified area sample design constructed by USDA and BLS in consonant procedures. The sample areas outside the boundaries of SMSA's were drawn by USDA and those within SMSA's by BLS. Approximately 2,500 farm dwellings were designated, of which 12 percent were within SMSA's.

In the first stage of the USDA sample, counties were grouped by State Economic Areas into 126 strata equal in weighted counts of rural farm and rural non-farm dwellings, as the same sample of counties was to be used for both farm and non-farm households. From each stratum, one county was chosen at random with a probability proportional to its weighted count. Counties were selected from 41 states. The parallel stage of the BLS design utilized the 34 SMSA's selected for the urban sample.

Within each sample county, sample segments were selected separately from rural places (100 to 2,500 inhabitants) and the open country. All dwellings in these segments were prelisted before the beginning of the survey and classified as farm or non-farm and subsampled at different rates. In the USDA sample, the number selected resulted from applying a sampling rate in each selected county so that the sample would be self-weighted. In the BLS sample, the number was allocated in advance, based on the number of farms in the stratum.

If a dwelling selected was vacant or if its occupants could not be located in two visits or were unable or unwilling to give the minimum information required for classifying the family, an alternate dwelling was selected.

All members of consumer units residing at a sample address were eligible for inclusion in the survey except for the time in the survey year during which they were living in military camps, posts, or reservations (other than periods of 45 days or less in a Reserve or National Guard Unit); in institutions;

abroad (except on vacation, etc.); or were members of another consumer unit. The tabulations in this report, however, cover only full-year consumer units; i.e., units with at least one member who was eligible for the entire survey year. If more than one consumer unit was living at an address, each unit was included in the sample.

Tabulation of Data

All interviews with farm families were conducted by USDA staff members and were virtually completed by the end of March 1962, although some field work continued into June. The questionnaire, which was a modification of the BLS questionnaire used in urban and rural non-farm areas, provided for detailed reporting of farm receipts, disbursements, and changes in farm assets but otherwise paralleled the BLS form. The questionnaire was detailed and designed with numerous probes and other aids to recall. Families were encouraged to refer to records wherever possible.

Reported receipts and disbursements were summarized and reviewed in the field to determine completeness, consistency, and balance of the family account. Families were re-interviewed when necessary to clarify ambiguous entries and to complete the record. The schedules were reviewed in the Washington office, primarily to determine conformance of the entries with the survey concepts and methodology. This review of the schedules was concentrated on sections which had proved most difficult in previous survey experience and on unusual situations which required specialized instructions. Completeness and reasonableness of the reported account, rather than the degree to which receipts and disbursements balanced, were the primary criteria for determining the acceptability of a schedule.

All data were edited, coded, and transferred to punch cards for tabulating with electronic data processing equipment. Numerous checks for internal consistency, reasonableness, and accuracy of the data were written into the programs for screening the machine listings of the data before tabulation.

Weighting of Data

To obtain the weights (i.e., the expansion factors), adjustments were made in the census total of persons in the population on April 1, 1960, to correct for definitional differences between the census and the CEIS universe. The CEIS data were related to consumer units, including one-person families, as they existed throughout the survey year, with the average family size reflecting the number of equivalent full-year members. It was necessary to adjust the census population on April 1, 1960, to obtain an estimate of the population for the year 1960. Adjustments were

made, therefore, to take account of births, deaths, and net civilian migration.

The adjusted rural farm population for each of the four regions was divided by the average size of consumer unit, as determined from the survey, to obtain the following estimates of the total number of consumer units:

Northeast	242,644
North Central	1,366,455
South	1,585,665
West	317,357
Total United States	3,512,121

Sample data for the four regions were expanded to these totals, which are consistent with corresponding totals used in the expansion and weighting of the rural non-farm and urban parts of the CEIS.

Evaluating Data

Data obtained from a sample survey as complex as the CEIS are subject to many types of errors. These include sampling, recording, and processing errors, as well as other errors due to the refusal or inability of some families to give the information requested.

All data were reviewed, edited, and screened to minimize processing errors. Usable schedules were furnished by about 76 percent of the families in the rural farm sample (Table 1). Some of the nonrespondents supplied limited information on family characteristics which was used by USDA to evaluate the nature of the sample losses due to nonresponse. Among the participating families, inaccurate reporting was a source of error despite continued research in schedule design and intensive training of the interviewers. Such inaccuracies resulted from memory errors, misunderstanding of a question or reluctance to answer it, and incorrect entries by the interviewer.

In using the CEIS data for analytical purposes and for comparison with related data from other sources, the limitations imposed by the basic orientation of the survey were recognized. The survey was designed to obtain the most accurate information possible about family expenditures and spending patterns in detail, including the quantities and prices of some purchases. Information on family income was needed for interpreting the expenditure pattern. To complete the account of the family's financial experience, information was requested on the net change in assets and liabilities for the 1961 calendar year.

If a family's 12-month accounts were complete and error-free, receipts would equal disbursements. Such precision, however, was almost never achieved. If a schedule met the test of the editing instructions with respect to internal completeness and consistency of expenditures with each other and with the family's

reported manner of living, the record was used, even though reported expenditures plus savings did not equal income. The amount of the discrepancy—the account-balancing difference—was recorded on the schedule; the average amount per family in the sample is shown in the tabulations. Schedules were not automatically rejected from the tabulations because of large balancing differences.

Definition of Terms

Family. The family, or consumer unit, refers to:

1. A group of people usually living together who pooled their income and drew from a common fund for their major items of expense.

2. A person living in a household or with others but who was financially independent; i.e., his income was not pooled and his expenditures were not met from a common fund. Never-married children living with parents were always considered as members of the consumer unit. Information was recorded for the family as it existed in the survey year.

Farm. The survey followed the definition used in the 1960 census. Dwellings were classified as on farms if they were on places of 10 or more acres from which sales of farm products amounted to \$50 or more in 1961 or if sales were \$250 or more, regardless of acreage. The rural farm population universe included all families living on farms.

Self-employed farm operator. A farmer who spent more than 50 percent of his working hours on the farm was classified as a self-employed farm operator, often referred to as a full-time farm operator.

Nonself-employed farm operator. A farmer who spent less than 50 percent of his working hours on the farm was classified as a nonself-employed farm operator, often referred to as a part-time farmer.

Nonself-employed non-farm operator. A rural family living on a farm which it was not farming.

Expenditures for current consumption (or current living expenses). The cost of goods and services for family living (including financing charges and sales and excise taxes) which were bought during the survey year were considered as consumption expenditures, regardless of whether or not payment was completed during the year. Consumer durable goods such as automobiles and household equipment were considered consumption items but purchases and sales of dwellings were considered as changes in assets. Family expenditures for items used partially for business, such as a car, were adjusted to exclude the amount chargeable to business use. The value of two nonmoney items, food and housing received as pay, were counted as money income and expenditures. Home-produced food was not included in expenditures.

Personal insurance. Personal insurance includes payments or deductions from pay for life, endowment, and annuity insurance; fraternal, union, and other mutual aid insurance; Social Security; and railroad, government, and other retirement plans. Employers' contributions were not included.

Gifts and contributions. Cash contributions to persons outside of the family and to welfare, religious, educational, and other organizations, including the cost of goods and services purchased in the survey year and given to persons outside of the family, were all recorded as consumption expenditures.

Net change in assets and liabilities. The algebraic sum of increases and decreases in assets and liabilities was used to estimate savings. Net increases in assets or decreases in liabilities represented a net saving during the year, while net decreases in assets or increases in liabilities represented a deficit (—) or net dissavings. The beginning and ending prices were used for inventory valuation. Appreciation of land owned by farm operators was not included.

Money income before taxes. Total family income during the survey year included all income of the family members from wages and salaries (including tips and bonuses) after deductions for such occupational expenses as tools, special required equipment, and union dues. Net income from self-employment (including farming) and income other than earnings such as net rents, interest, dividends, Social Security benefits, pensions, disability insurance, trust funds, small gifts of cash, regular contributions for support, public assistance, or other governmental payments were also included. The value of two nonmoney items, food and housing received as pay, was counted as money income and as expenditures. Farm income was adjusted for changes in inventory of crops and livestock. The value of home-produced food did not enter into the computation of income.

Money income after taxes. Total income after deduction of personal taxes (Federal, state and local income taxes, poll taxes, and personal property taxes) was considered a component of personal income.

Other money receipts. Inheritance and occasional large gifts of money less taxes, legal fees, and other expenses required to obtain such receipts and net receipts from the lump-sum settlement of fire and accident insurance policies were also considered as components of disposable income. Gifts and inheritances in the form of real estate, securities, and other property were not included unless the assets were sold during the survey year.

Account-balancing differences. The difference between reported total receipts and reported total disbursements arising from reporting errors were account-

balancing differences. Total receipts were composed of income after taxes, other money receipts, and money or credit received from decreasing assets or increasing liabilities. Total disbursements consisted of expenditures for current consumption, personal insurance, gifts and contributions, and outlays of money which resulted in increasing assets or decreasing liabilities.

Analysis of Data

As the measurements for consumption expenditures, savings, and disposable income for U. S. farm families were made in 1961, the question arose whether 1961 was a typical year. Assuming that the linear regression trend for the 16-year period 1951-66 is a benchmark reference for typical years, the residual values then serve as an indicator.

Actual, predicted, and residual measurements are given for 1961 aggregate personal income for farm population from farm sources, Y_1 , non-farm sources, Y_2 , and from all sources, Y_3 (Table 2). Aggregate personal income from farm sources was \$234 million less than predicted but aggregate personal income from non-farm sources was \$115 million more than predicted. Personal income from all sources, which includes components Y_1 and Y_2 , was \$118 million less than predicted. Disposable personal income

TABLE 2.—Actual, Predicted, and Residual Values for Seven U.S. Aggregate Income Variables for Agricultural Sector, 1961, in Billions of Current Dollars (Based on 16-Year 1951-66 Linear Regression Trends).

Variable*	Actual†	Predicted‡	Residual**
Y_1	12.109	12.343	—0.234
Y_2	6.924	6.809	+0.115
Y_3	19.033	19.152	—0.118
Y_4	17.616	17.763	—0.147
Y_5	39.927	40.808	—0.881
Y_6	27.013	27.606	—0.593
Y_7	12.914	13.203	—0.289

* Y_1 —Aggregate personal farm income for farm population from farm sources.

Y_2 —Aggregate personal farm income for farm population from non-farm sources.

Y_3 —Aggregate personal income for farm population from all sources.

Y_4 —Aggregate disposable income for farm population.

Y_5 —Aggregate gross income for farm population including government payments.

Y_6 —Aggregate production expenses including government payments.

Y_7 —Aggregate net income of farm operators including government payments.

†Actual measurement in current 1961 dollars.

‡Predicted measurement in current 1961 dollars.

**Residual—difference between actual and predicted measurements.

Source: U. S. Dept. of Agriculture, July 29, 1967. Farm Income Situation, Economic Research Service, FIS—207, pp. 48, 49, 52, 57.

TABLE 3.—Actual, Predicted, and Residual Values for Three U.S. Farm Operator Variables for Agricultural Sector, 1961, in Current Dollars (Based on 16-Year 1951-66 Linear Regression Trends).

Variable*	Actual†	Predicted‡	Residual**
Y ₁	3,389	3,505	-116
Y ₂	2,285	2,224	+ 61
Y ₃	5,674	5,729	- 55

*Y₁=U.S. average net income per farm from farm sources, including non-money income for food and housing.

Y₂=U.S. average off-farm income per farm from non-farm sources.

Y₃=U.S. average net income per farm, including non-money income for food and housing.

†Actual measurement in current 1961 dollars.

‡Predicted measurement in current 1961 dollars.

**Residual—difference between actual and predicted measurements.

Source: U.S. Dept. of Agriculture, July 29, 1967. Farm Income Situation. Economic Research Service, FIS—207, p. 50.

for farm population, Y₄, was \$147 million less than predicted by the regression trend line.

Aggregate gross income for farm population, Y₅, was \$881 million less than predicted and aggregate productive expense, Y₆, was \$593 million less than the predicted value. Aggregate net income for farm operators, Y₇, was \$289 million less than predicted for 1961.

Three similar measurements for farm operators are presented in Table 3. Farm operators' average net income from farm sources, Y₁, was \$116 less than predicted, while farm operators' average total off-farm income, Y₂, was \$61 greater than predicted. Total average net income per farm, composed of dependent variables Y₁ and Y₂, was \$55 less than predicted by the regression trend line.

Aggregate and average per farm operator income measurements both revealed that farm income was less than predicted for 1961 but non-farm income was greater than predicted. Consequently, total net income was only slightly lower than predicted by the regression trend line. As total net income was assumed to have a high correlation with disposable income, it was concluded that 1961 was a fairly typical year for income measurements.

Aggregation of Data

Aggregation of data was necessary to obtain estimated measurements for consumption, C; for savings, S; and for income, Y.

The estimated consumption measurement, C, was computed by the summation of the following three survey measurements:

1. Expenditure for current consumption, total.
2. Personal insurance, total.
3. Gifts and contributions, total.

The estimated savings measurement, S, was obtained directly from the net change in assets and liabilities.

The estimated disposable income measurement, Y, was computed by the summation of the following three survey measurements:

1. Money income after personal taxes.
2. Other money income.
3. Accounting difference. Negative values added; positive values subtracted.⁸

With this aggregation, estimates were obtained for each full-time and part-time farm operator, providing estimated measurements for the following identity:

$$Y \equiv C + S \quad (1)$$

The Finite Universe—Rural Farm Population

The finite universe was the rural farm population of the United States in 1961. The estimated size of the universe, N, was 3,512,121 families and the sample size, n, was 1,967 (Table 4).

The sample was composed of the following three sub-groups: full-time farm operators, part-time farm operators, and non-farm operators. The sample size, consumption mean, standard deviation, and standard error of the mean for full-time farm operators and for part-time farm operators are presented in Appendix Table II.

The following hypotheses concerning the consumption mean for each group was:

$$H_0: \bar{C}_1 = 0$$

$$H_0: \bar{C}_2 = 0$$

⁸In a telephone interview Jan. 15, 1968, Tom Lanahan, Division of Living Conditions, U. S. Bureau of Labor Statistics, Washington, D.C., stated that families have a tendency to underestimate their income and consequently income was adjusted for the accounting differences. Average accounting difference per schedule was \$13.79.

TABLE 4.—Size of Sample, Percent of Total Sample, and Estimated Number of Families in U.S. Rural Farm Population by Full-time, Part-time, and Non-farm Operators, 1961.

	n*	%†	N‡
Full-time Farm Operators	1306	66.40	2,331,968
Part-time Farm Operators	489	24.86	873,083
Non-farm Operators	172	8.74	306,949
Total	1967	100.00	3,512,000

* n = Number of observations in sample.

† % = Derived percentage of rural farm population in the stratum.

‡ N = Derived aggregate number of rural farm families in the stratum.

Source: U.S. Dept. of Agriculture, Consumer Expenditure and Income Survey, Rural Farm Population, United States, 1961.

where:

\bar{C}_1 = Consumption mean for full-time farm operators

\bar{C}_2 = Consumption mean for part-time farm operators

The computed t values for the consumption means were 5.78 for full-time farm operators and 3.77 for part-time farm operators. Both hypotheses were rejected at the .05 level of significance. The two consumption means were statistically significantly different from zero at the .05 level of significance. The 95 percent confidence coefficient inferred that there was a 95 percent probability that the true value of the consumption mean was not zero.

Inferences about variance. An F probability distribution was used to determine if the consumption variances for full-time farm operators and for part-time farm operators samples were homogeneous. The hypothesis was:

$$H_0: \frac{\sigma_1^2}{\sigma_2^2} = \frac{\sigma_2^2}{\sigma_2^2}$$

where:

σ_1^2 = Consumption variance for full-time farm operators

σ_2^2 = Consumption variance for part-time farm operators

Level of significance: .05

The computed F statistic was as follows:

$$F = \frac{\frac{\sigma_1^2}{\sigma_1^2}}{\frac{\sigma_2^2}{\sigma_2^2}} = \frac{29,163,235,816}{12,006,983,287} = 2.429$$

where:

$$\frac{\sigma_1^2}{\sigma_1^2} > \frac{\sigma_2^2}{\sigma_2^2}$$

The interpolated table values for the F statistic were as follows:

$$F = F_{.95} (1000, 500) \approx 1.13$$

Reject if $F \leq 1.13$.

The one-tailed test for the null hypothesis was not accepted at the .05 level of significance; i.e., the variance for the part-time farm operators was not statistically significantly different from the variance for the full-time operators. This inferred that the

variance for consumption expenditures between full-time and part-time farm operator families was significantly different at the 95 percent probability level.

Significance of the difference between two sample means. The significance of the difference between the consumption means for full-time farm operators and for part-time farm operators with unequal variance was tested⁹ as follows:

Hypothesis: $H_0: \bar{C}_1 = \bar{C}_2$

Level of significance: .05

Test criteria:

$$t = \frac{\bar{C}_1 - \bar{C}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

Region of rejection:

$t_{.975, \infty} = 1.96$ for upper .025

$t_{.025, \infty} = -1.96$ for lower .025

Computation:

$$t = \frac{4003.925 - 4274.303}{\sqrt{\frac{29,163,235,816}{1306} + \frac{12,006,983,287}{489}}} = -.039$$

Accept: $H_0: \bar{S}_1 = \bar{S}_2$

The consumption means for full-time farm operators and for part-time farm operators at the .05 level of significance were not statistically significantly different. This inferred that the consumption means were from two different universes having the same means. Because of the difference in variance between the two universes, full-time farm operators and part-time farm operators were analyzed as two different universes in this inquiry.

Macro Analysis

The estimated parameters for the average U. S. full-time farm operator and for the average U. S. part-time farm operator consumption function was as follows:

Full-time farm operator average consumption function:

$$C = \$2503 + .326Y$$

Part-time farm operator average consumption function:

$$C = \$1390 + .618Y$$

The statistics associated with this model are tabulated in Appendix Table III.

One of the basic assumptions in least squares is that of equal variance. Since a statistically signifi-

⁹The degrees of freedom for the t statistic used are usually estimated by an appropriate formula. However, since n_1 and n_2 were very large, infinity was used for degrees of freedom.

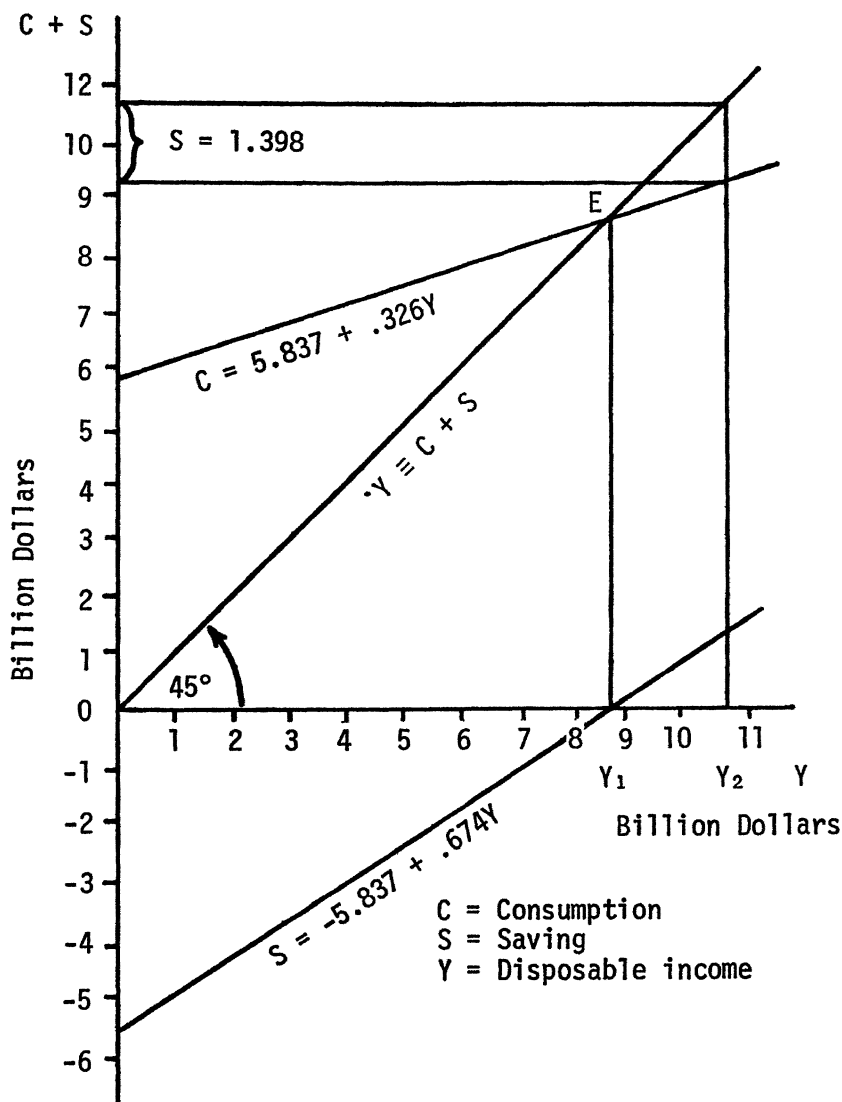


Fig. 4.—Structure of the Short Run Macro Consumption and Saving Functions, U. S. Full-time Farm Operators, 1961. (Source: Table 4, Appendix Table III.)

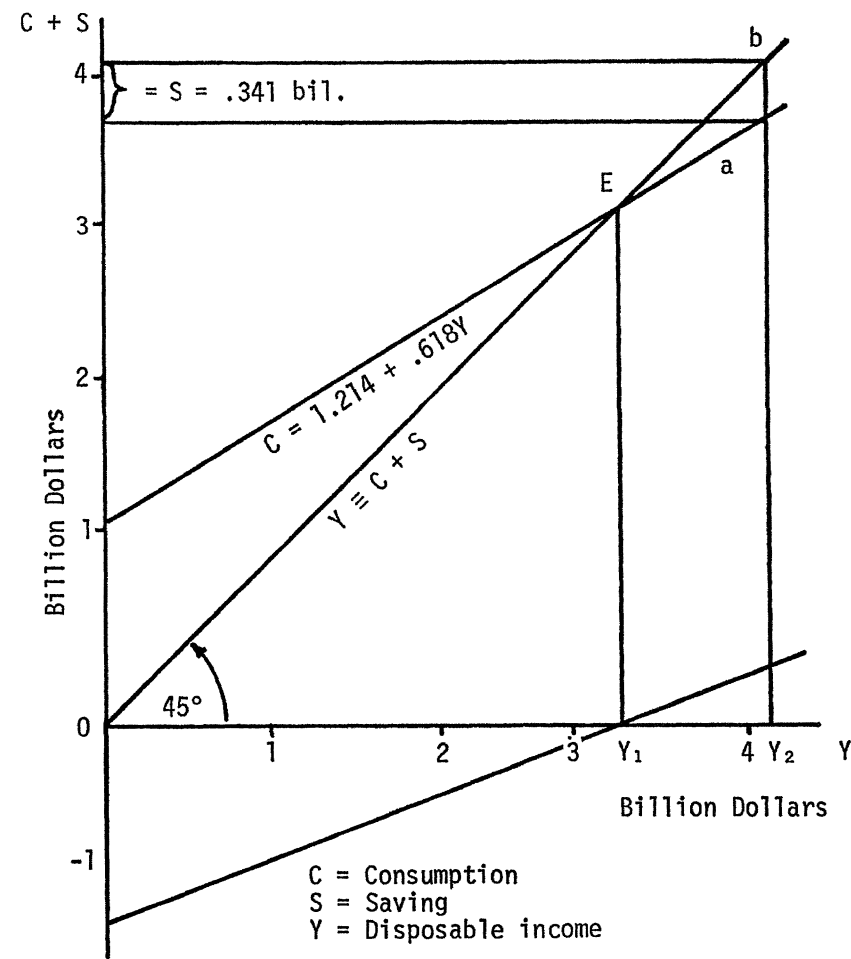


Fig. 5.—Structure of the Short Run Macro Consumption and Saving Functions for U. S. Part-time Farm Operators, 1961. (Source: Table 4, Appendix Table III.)

cant difference at the .05 level was found between the consumption variances for full-time and part-time farm operators, aggregate consumption was not regressed on aggregate disposable income to estimate the parameters for the U. S. farm operator's average consumption.

The estimated macro consumption function for the full-time farm operators and part-time farm operators in the U. S. agricultural sector were weighted by the number of full-time and part-time farm operators in the U. S. population. In 1961, the USDA estimated 3,512,000 farm operators and non-farm operators¹⁰ in the total farm population. Based on the sample of 1,967 observations for the rural farm population sector, U. S. full-time farm operators represented about 66 percent, part-time farm operators about 25 percent, and non-farm operators represented the residual of about 9 percent of the total U. S. farm population in 1961 (Table 4). Using these estimates, aggregate U. S. full-time farm operators were estimated at 2,331,968 and part-time farm operators at 873,083 in 1961.

With these estimates, parameters for the macro consumption function for the full-time and the part-time farm operator sectors were estimated by the product of the means of disposable income, \bar{Y} , and mean consumption, \bar{C} , by the estimated number of farm operators, N , in each population, Table 5. Estimates for the parameters in billion dollars for the full-time operator sector were as follows:

$$C = \$5.837 + .326Y \\ (.0118)$$

The macro consumption function for the U. S. part-time farm operator sector in billion dollars was:

¹⁰Rounded to the nearest 1000.

TABLE 5.—Aggregate Income and Consumption and Consumption at Zero Level of Income by U. S. Full-time, Part-time, and Aggregate Farm Operators, 1961.

Symbols*	Full-time Farm Operators	Part-time Farm Operators	Aggregate U. S. Farm Operators
$\bar{Y} \times N$	\$10,735,356,938	\$ 4,073,062,284	\$14,808,419,222
$\bar{C} \times N$	9,337,024,974	3,731,826,524	13,068,851,498
$\bar{b}_0 \times N$	5,836,915,904	1,213,585,370	7,050,501,274

* $\bar{Y} \times N$ = Product of mean disposable income and number of rural farm families equals aggregate disposable income for the sector.

$\bar{C} \times N$ = Product of mean savings and number of rural farm families equals aggregate consumption expenditures for the sector.

$\bar{b}_0 \times N$ = Product of mean level of consumption at zero income and number of rural farm families equals consumption expenditures at zero income for the sector.

Source: Table 3 and Appendix Table III.

TABLE 6.—Relation Between Consumption and Income for Aggregate U. S. Farm Operators, Full-time and Part-time Farm Operators, 1961.

Group	APC*	IEC†	MPC‡	k**
Aggregate U.S. Farm Operators	.883	.460	.406	1.68
Full-time Farm Operators	.870	.375	.326	1.48
Part-time Farm Operators	.916	.675	.618	2.62

*Average propensity to consume. Ratio of arithmetic mean consumption to arithmetic mean disposable income.

†Income elasticity of consumption. Derived by dividing MPC by APC.

‡Marginal propensity to consume.

**Multiplier $\frac{1}{(1-MPC)}$.

Source: Appendix Table III.

$$C = \$1.214 + .618Y \\ (.0205)$$

These relationships are presented in Figures 4 and 5.

The macro model of the U. S. agricultural sector was constructed by adding the aggregate consumption at zero disposable income in the full-time and the part-time farm operator macro models together. Disposable income in both macro models was likewise added and the weighted average propensity to consume was estimated by using the following formula:

$$b_1 = \frac{n_1 (b_{1_F}) + n_2 (b_{1_P})}{n_1 + n_2} \quad (11)$$

where:

b_1 = MPC for U. S. farm operators

n_1 = Sample size for full-time farm operators

n_2 = Sample size for part-time farm operators

b_{1_F} = MPC for full-time farm operators

b_{1_P} = MPC for part-time farm operators

The weighted MPC for the aggregate U. S. farm operator sector was as follows:

$$b_1 = \frac{1306 (.3260) + 489 (.6182)}{1306 + 489} \\ b_1 = .4056$$

The macro consumption function for U. S. farm operators in billions of dollars was estimated as follows:

$$C = \$7.051 + .406Y$$

The structure of the short run macro consumption function for U. S. farm operators in 1961 is presented in Figure 6. The average propensity to consume, income elasticity of consumption, and the marginal propensity to consume are presented in Table 6.

Macro analysis derived estimates. The macro models indicated that U. S. farm operators had a rela-

tively low MPC and a relatively high MPS. There was a great difference between full-time farm operators' MPC (.326) compared to part-time farm operators' MPC (.674). Aggregate U. S. farm operators saved about 11.7 percent of their disposable income compared to 13.0 percent for U. S. full-time farm operators and 8.4 percent for U. S. part-time farm operators. U. S. aggregate farm operators had an APC of 88.3 percent compared to 87.0 percent for U. S. full-time farm operators and 91.6 percent for U. S. part-time farm operators.

The APC for U. S. farm operators was consistent with Friedman's findings (Appendix Table I). Income elasticity measurements indicated a highly inelastic income elasticity of consumption. The more risk and uncertainty associated with a group of entrepreneurs, the lower the APC and the MPC. Part-time farm operators received a greater portion of their income from non-farm sources and it was less vari-

able.¹¹ With less risk and uncertainty, U. S. part-time farmers had a higher APC and MPC compared to the U. S. full-time farm operator sector.

Segmented Model

The segmented model was employed to estimate consumption expenditures by each income stratum. Probability estimates for farm operator consumption expenditures may be derived either from the macro or the segmented model by using the standard error of forecast. To determine the best of the two models, the following statistical tests were employed.

Interaction analysis. To determine the effect of the interaction of both levels and slopes, the ten stratified samples for both full-time farm operators and part-time farm operators were tested for interaction, using two sets of dummy variables.

¹¹Table 1, independent variable Y_{15} .

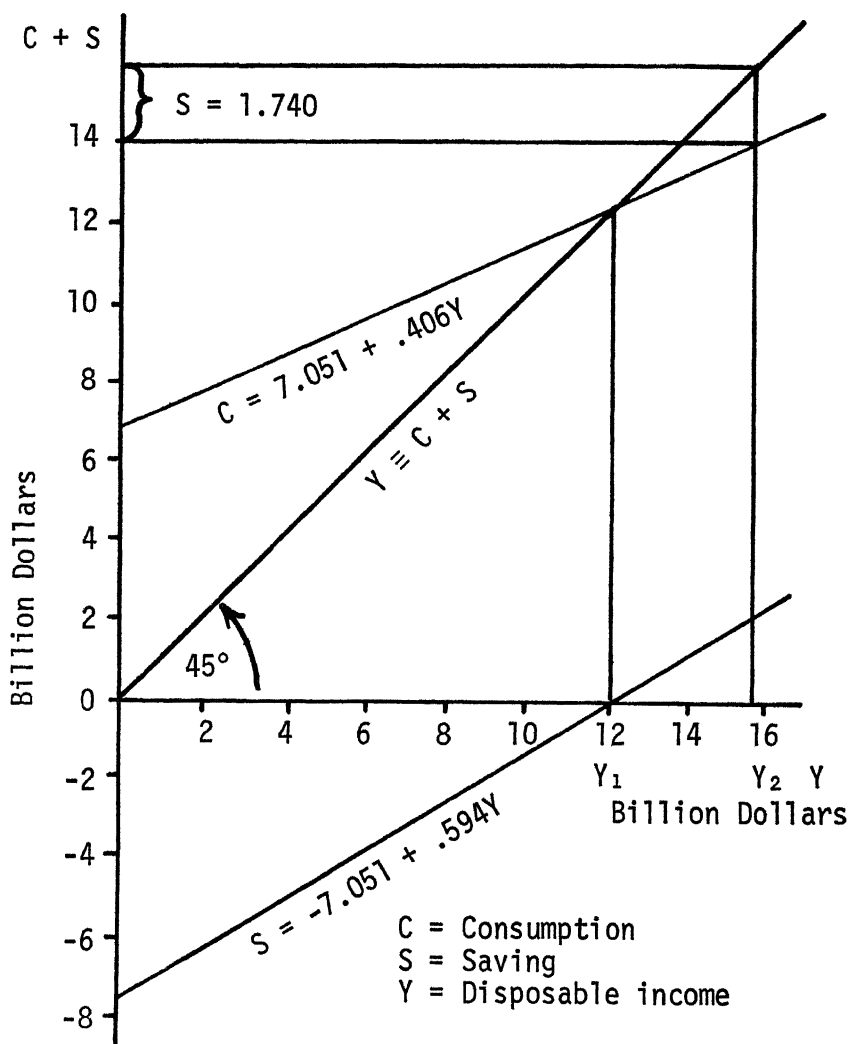


Fig. 6.—Structure of the Short Run Macro Consumption and Saving Functions, U. S. Farm Operators, 1961. (Source: Table 4.)

The statistical model used for this test was:

$$C = b_0 + \sum_{i=1}^9 d_i D_i + b_1 Y + \sum_{i=1}^9 c_i (D_i Y) + u \quad (5)$$

where:

C = Consumption
 b_0 = Level of consumption function for average full-time farm operator
 b_1 = Slope of consumption function for average full-time farm operator
 Y = Disposable income
 d_i = Regression coefficient for dummy variable D_i
 c_i = Regression coefficient for product of dummy variable and disposable income for stratum i
 D_i = Dummy variable for stratum i
 u = Statistical error term

A. Full-time farm operator hypotheses—consumption function. Hypotheses tested were as follows:

No. 1 $H_0: R^2 = 0$

Rejected H_0 at the .05 level of significance, using the F probability distribution.

There was a relationship between consumption and disposable income at the .05 level of significance.

No. 2 Multiple hypotheses: The added contribution of the stratified slopes (MPC's) to total R^2 and the added contribution of the stratified levels to total R^2 were estimated by making the following two a priori restrictions.

$$1. \sum_{i=1}^9 c_i = 0$$

Statistical model was as follows:

$$C = b_0 + \sum_{i=1}^9 d_i D_i + b_1 Y + u \quad (6)$$

No. 1 $H_0: R^2$ added contribution of

$$\sum_{i=1}^9 c_i \text{ to total } R^2 = 0.$$

Rejected H_0 at the .05 level of significance, using the F probability distribution.

The added contribution of

$$\sum_{i=1}^9 c_i$$

to total R^2 was significant at the .05 level of significance. Therefore, there was a significant difference between slopes (MPC's) by income strata.

$$2. \sum_{i=1}^9 d_i = 0$$

Statistical model was as follows:

$$C = b_0 + b_1 Y + \sum_{i=1}^9 c_i (D_i Y) + u \quad (7)$$

No. 1 $H_0: R^2$ added contribution of

$$\sum_{i=1}^9 d_i D_i \text{ to total } R^2 = 0.$$

Rejected H_0 at the .05 level of significance, using the F probability distribution.

The added contribution of

$$\sum_{i=1}^9 d_i D_i$$

to total R^2 was significant at the .05 level of significance. Therefore, there was a significant difference between consumption levels by income strata.

Added contribution of

$$\sum_{i=1}^9 d_i (D_i Y) \text{ and } \sum_{i=1}^9 d_i D_i$$

to total R^2 in statistical model 9 was:

$R^2 = .5301$ with

$$\sum_{i=1}^9 c_i (D_i Y) \text{ and } \sum_{i=1}^9 d_i D_i \text{ included.}$$

$R^2 = .5104$ with $\sum_{i=1}^9 c_i (D_i Y)$ excluded. Added contribution to $R^2 = .0194$.

$R^2 = .4862$ with $\sum_{i=1}^9 d_i D_i$ excluded. Added contribution to total $R^2 = .0439$.

B. Part-time farm operator hypotheses—consumption function. The identical statistical model No. 5 was used for the part-time farm operator sector.

$$C = b_0 + \sum_{i=1}^9 d_i D_i + b_1 Y + \sum_{i=1}^9 c_i (D_i Y) + u$$

Hypotheses were as follows:

No. 1 $H_0: R^2 = 0$

Rejected H_0 at the .05 level of significance, using the F probability distribution.

There was a statistically significant relationship between savings and disposable income at the .05 level of significance.

No. 2 Multiple hypotheses: The added contribution of the stratified slopes (MPC's) to total R^2 and the added contribution of the stratified levels to total R^2 were estimated by making the following two a priori restrictions.

$$1. \sum_{i=1}^9 c_i = 0$$

Statistical model was as follows:

$$C = b_0 + \sum_{i=1}^9 d_i D_i + b_1 Y + u \quad (6)$$

No. 1 $H_0: R^2$ added contribution of

$$\sum_{i=1}^9 c_i (D_i Y) \text{ to total } R^2 = 0.$$

TABLE 7.—Coefficient of Determination Values for Full-time and Part-time Consumption Functions by Various Statistical Models, U. S. Agricultural Sector, 1961.

Statistical Model	Equation Identity	Consumption Functions—Coefficient of Determination Values	
		Full-Time Farm Operators	Part-Time Farm Operators
$C = b_0 + b_1 Y + u$	(4)	.3680	.6523
$C = b_0 + \sum_{i=1}^9 d_i D_i + b_1 Y + \sum_{i=1}^9 c_i (D_i Y) + u$	(5)	.5301	.7509
$C = b_0 + \sum_{i=1}^9 d_i D_i + b_1 Y + u$	(6)	.5104	.7367
$C = b_0 + b_1 Y + \sum_{i=1}^9 c_i (D_i Y) + u$	(7)	.4862	.7295

Source: U. S. Dept. of Agriculture. Consumer Expenditure and Income Survey, Rural Farm Population, United States, 1961.

Rejected H_0 at the .05 level of significance, using the F probability distribution.

The added contribution of

$$\sum_{i=1}^9 c_i (D_i Y)$$

to total R^2 was statistically significant at the 5 percent level of significance. Therefore, there was a significant difference between income slopes (MPC's) by income strata.

Using the No. 2 multiple hypothesis, the consumption statistical model was as follows:

$$2. \sum_{i=1}^9 d_i D_i = 0$$

$$C = b_0 + b_1 Y + \sum_{i=1}^9 c_i (D_i Y) + u \quad (7)$$

$$\text{No. 2 } H_0: R^2 \text{ added contribution of } \sum_{i=1}^9 d_i D_i \text{ to total } R^2 = 0.$$

Rejected H_0 at the .05 level of significance, using the F probability distribution.

The added contribution of

$$\sum_{i=1}^9 d_i D_i$$

to total R^2 was statistically significant. Therefore, there was a significant difference between consumption slopes (MPC's) by income strata.

Added contribution of

$$\sum_{i=1}^9 c_i (D_i Y) \text{ and } \sum_{i=1}^9 d_i D_i$$

to total R^2 in mathematical model 9 was as follows:

$$R^2 = .7509 \text{ with}$$

$$\sum_{i=1}^9 c_i (D_i Y) \text{ and } \sum_{i=1}^9 d_i D_i \text{ included.}$$

$$R^2 = .7367 \text{ with } \sum_{i=1}^9 c_i \text{ excluded. Added contribution to total } R^2 = .0142.$$

$$R^2 = .7295 \text{ with } \sum_{i=1}^9 d_i D_i \text{ excluded. Added contribution to total } R^2 = .0214.$$

These statistical tests revealed that there was significant interaction between the average consumption level and slope (MPC) and the strata levels and slopes (MPC's) at the .05 level of significance.

Probability Model

The findings from these statistical tests provided strong evidence that the segmented model was superior to the macro model for estimating the probability levels of consumption for individual farm operators by disposable income strata.

Interaction analysis, with both levels and slopes for the segmented consumption functions allowed to be free, indicated that the segmented consumption function levels and slopes made a statistically significant added contribution to total R^2 at the 5 percent level of significance.

Interaction model 5 provided the greatest R^2 for the consumption functions for full-time farm operators and part-time farm operators (Table 7). Based on these findings, the segmented model with separate consumption functions for each stratum was used to estimate probabilities of consumption expenditures for individual full-time and part-time farm operators.

Statistics for the segmented models. To derive the standard error of forecast for each stratum in both full-time and part-time farm operator segmented models, estimated parameters for the segmented consumption functions and selected statistics were computed.

The parameter estimates and associated statistics for the segmented consumption functions for full-time farm operators are tabulated in Appendix Table IV and illustrated in Figure 7. Parameter estimates and associated statistics for the part-time farm operators' segmented consumption functions are tabulated in Appendix Table V and illustrated in Figure 8. These parameter estimates were the same estimates obtained in the interaction analysis. However, the interaction model did not provide the necessary associated statistics for estimating the standard error of forecast.

Standard error of forecast. To minimize the b_1 error (MPC), the standard error of forecast, \hat{S}_F , was estimated at the mean disposable income value for each stratum in both the full-time and the part-time farm operator segmented models. This procedure also minimized the computations as the b_1 error component in the \hat{S}_F equation was removed, which reduced the standard error of forecast equation to the following:

$$\text{Standard error of forecast equation, given } Y_0 \\ = \bar{Y} \\ \hat{S}_F = S_{e,y} \sqrt{1 + \frac{1}{n}}$$

where:

\hat{S}_F = Standard error of forecast

$S_{e,y}$ = Standard error of estimate

1 = One deviation for individual observation

n = Sample size

\bar{Y} = Mean value of disposable income for stratum i

Y_0 = Value of individual disposable income observation in stratum i .

Using statistics from Appendix Table IV, standard errors of forecast for each of the ten segments for full-time farm operators were estimated and are shown in Appendix Table VI. The same procedure was followed for estimating the standard errors of forecast for the ten part-time farm operator segments by using statistics from Appendix Table V. These standard errors of forecast are shown in Appendix Table VII.

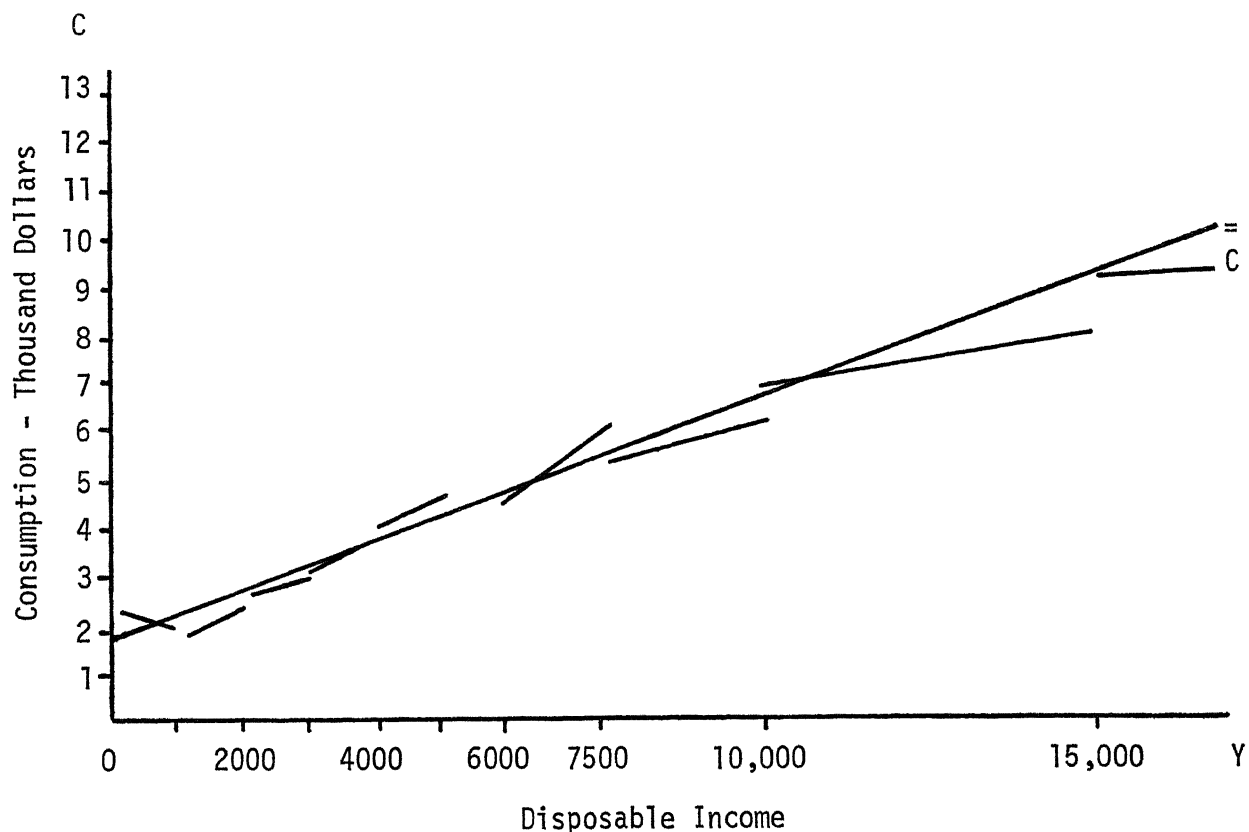


Fig. 7.—Interaction of Consumption Function Levels and Slopes by Disposable Income Strata as Related to Average Consumption Function, U. S. Full-time Farm Operators, 1961. (Source: Appendix Tables III and IV.)

Probabilities of Annual Consumption Expenditures

Estimating equation 9 was used to regress consumption (C) on disposable income (Y) for each disposable income stratum for full-time farm operators and part-time farm operators. Estimated parameters and associated statistics for the full-time farm operator segments, tabulated in Appendix Tables IV and V, were used to estimate the standard error of forecast, \hat{S}_F . The standard error of forecast estimating equation (8) was used for each disposable income stratum. Standard errors of forecast are tabulated in Appendix Table VI for each of the ten full-time farm operator disposable income strata at the mean disposable income value. The standard errors of forecast are tabulated in Appendix Table VII for part-time farm operators.

Estimating equation 10 was used to derive probabilities for various minimum consumption expenditures as related to disposable income levels. The probability for an individual consumption level, given the individual disposable income observation, Y_o , in

stratum i was then estimated by use of the probability values under the normal density function.

Probabilities for an individual full-time farm operator's annual consumption expenditures are tabulated in Table 8. Each probability was estimated at the mean disposable income value for each stratum rounded to \$100, by various levels of minimum consumption expenditures. The same procedure was followed in estimating probabilities for part-time farm operators (Table 9).

Probabilities interpretation. The interpretation of consumption probabilities is very simple. For example, given a disposable income of \$8,500 for a full-time farm operator, the probability of consumption expenditure of \$1,000 or more is 99 percent. The same individual farm operator has a 7.5 percent probability of a \$4,000 annual consumption expenditure.

For a given disposable income level of \$8,500, the difference between a \$4,000 and a \$5,000 consumption expenditure is 17 percent. Consequently, about 17 percent of the full-time farm operators spent between \$4,000 and \$5,000 for consumption expenditures in 1961.

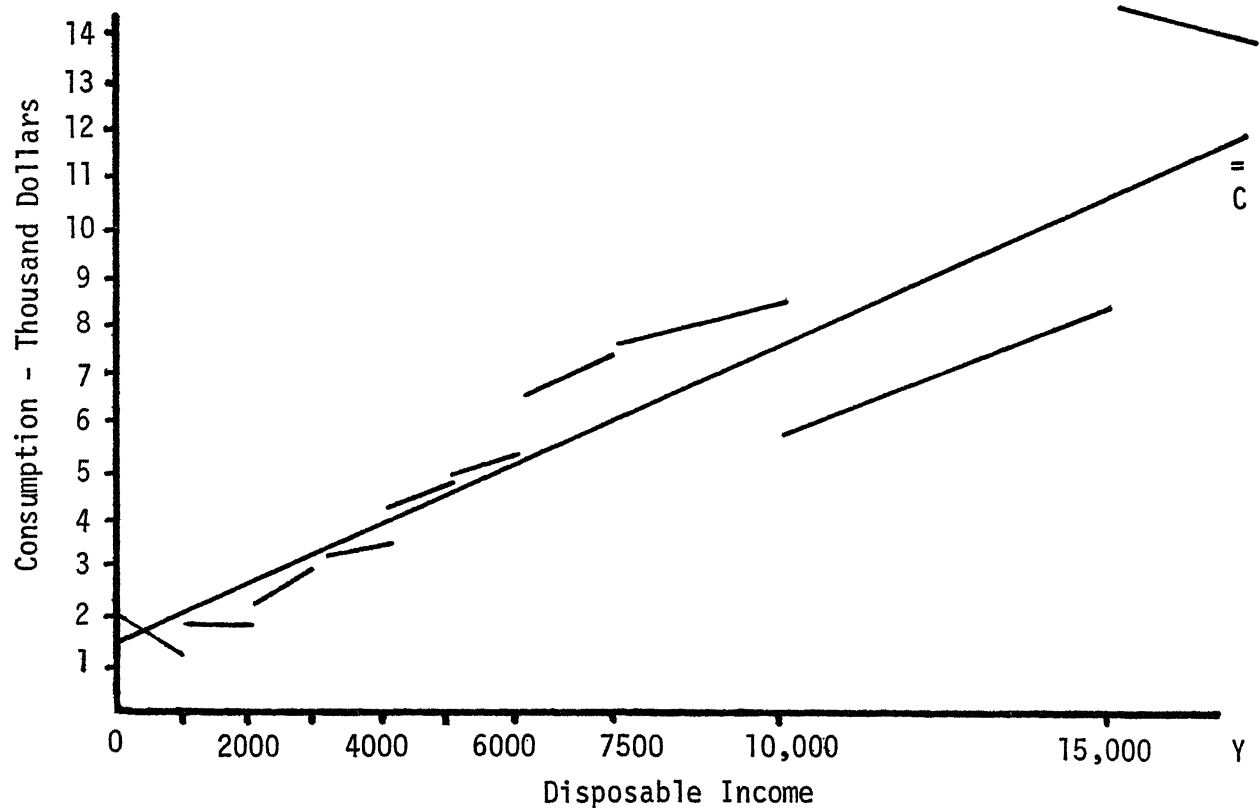


Fig. 8.—Interaction of Consumption Function Levels and Slopes by Disposable Income Strata as Related to Average Consumption Function, U. S. Part-time Farm Operators, 1961. (Source: Appendix Tables III and V.)

TABLE 8.—An Individual U.S. Full-time Farm Operator's Probability of Consumption Expenditures by Disposable Income, 1961.

Minimum Consumption Expenditures	Full-time Farm Operator Disposable Income								
	\$1500	\$2500	\$3500	\$4500	\$5500	\$6750	\$8500	\$12,000	\$22,600
\$ 1,000	.85	.92	.98	.97	.99	1.00	.99	.98	.98
2,000	.55	.75	.89	.91	.95	.97	.96	.95	.96
3,000	.21	.43	.67	.78	.84	.91	.88	.91	.94
4,000	.04	.18	.36	.58	.64	.77	.75	.85	.91
5,000	—	.05	.13	.36	.40	.55	.58	.76	.86
6,000	—	.01	.03	.18	.19	.32	.37	.67	.81
7,000	—	—	—	.07	.07	.14	.20	.55	.74
8,000	—	—	—	.02	.02	.05	.09	.42	.67
9,000	—	—	—	—	—	.01	.03	.31	.58
10,000	—	—	—	—	—	—	.01	.21	.50
11,000	—	—	—	—	—	—	—	.13	.41
12,000	—	—	—	—	—	—	—	.08	.32
13,000	—	—	—	—	—	—	—	.04	.25
14,000	—	—	—	—	—	—	—	.02	.18
15,000	—	—	—	—	—	—	—	.01	.13
16,000	—	—	—	—	—	—	—	—	.09
17,000	—	—	—	—	—	—	—	—	.06
18,000	—	—	—	—	—	—	—	—	.04
19,000	—	—	—	—	—	—	—	—	.02
20,000	—	—	—	—	—	—	—	—	.01
21,000	—	—	—	—	—	—	—	—	.01

Source: Appendix Tables IV and VI.

Note: Probabilities in light face type indicate the percent of individual full-time farm families with consumption expenditures greater than disposable income in each disposable income stratum.

TABLE 9.—An Individual U.S. Part-time Farm Operator's Probability of Consumption Expenditures by Disposable Income, 1961.

Minimum Consumption Expenditures	Part-time Farm Operator Disposable Income								
	\$1500	\$2500	\$3400	\$4600	\$5500	\$6600	\$8500	\$11,600	\$18,200
\$ 1,000	.91	.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2,000	.47	.75	.96	.99	1.00	1.00	1.00	1.00	.92
3,000	.07	.26	.67	.91	.96	.97	.99	1.00	.88
4,000	—	.02	.20	.63	.81	.89	.98	.99	.84
5,000	—	—	.02	.24	.50	.71	.92	.97	.78
6,000	—	—	—	.04	.19	.46	.81	.93	.71
7,000	—	—	—	—	.04	.21	.63	.84	.63
8,000	—	—	—	—	—	.07	.41	.70	.55
9,000	—	—	—	—	—	.02	.22	.54	.46
10,000	—	—	—	—	—	—	.09	.36	.37
11,000	—	—	—	—	—	—	.03	.21	.30
12,000	—	—	—	—	—	—	.01	.10	.23
13,000	—	—	—	—	—	—	—	.04	.17
14,000	—	—	—	—	—	—	—	.01	.12
15,000	—	—	—	—	—	—	—	—	.08
16,000	—	—	—	—	—	—	—	—	.05
17,000	—	—	—	—	—	—	—	—	.03
18,000	—	—	—	—	—	—	—	—	.02
19,000	—	—	—	—	—	—	—	—	.01
20,000	—	—	—	—	—	—	—	—	.01

Source: Appendix Tables V and VII.

Note: Probabilities in light face type indicate the percent of individual part-time farm families with consumption expenditures greater than disposable income in each disposable income stratum.

SUMMARY AND CONCLUSIONS

Summary

The estimated parameters for the linear consumption function for the average full-time and part-time farm operator in 1961 were:

Statistical model

$$C = b_0 + b_1 Y + u$$

where:

C = Average consumption expenditures

b_0 = Average level of consumption function

b_1 = Average slope of consumption function (MPC)

Y = Disposable income

Average U. S. full-time farm operator consumption function:

$$C = \$2503 + .326Y \\ (.0118)$$

Average U. S. part-time farm operator consumption function:

$$C = \$1390 + .618Y \\ (.0205)$$

Due to the difference in variance, the consumption function for the average U. S. farm operator was estimated by adding the full-time and part-time sectors together and then dividing by the number of farm operators in the U. S. agricultural sector. The average MPC was estimated by weighting the MPC's for the full-time and part-time farm sectors.

Aggregate consumption function for U. S. agricultural sector:

$$C = \$2200 + .406Y$$

Estimated aggregate disposable income, consumption expenditures and savings in 1961 for the aggregate U. S. farm operator sector, for the full-time farm operator sub-sector, and for the part-time farm operator sub-sector were:

Aggregate U. S. farm operator sector:

Aggregate disposable income = \$14.8 billion

Aggregate consumption = \$13.1 billion

Aggregate net saving = \$ 1.7 billion

Aggregate full-time farm operator sub-sector:

Aggregate disposable income = \$10.7 billion

Aggregate consumption = \$ 9.3 billion

Aggregate net saving = \$ 1.4 billion

Aggregate part-time farm operator sub-sector:

Aggregate disposable income = \$ 4.1 billion

Aggregate consumption = \$ 3.7 billion

Aggregate net saving = \$ 0.3 billion

Average propensities to consume (APC) were:

APC

Aggregate U. S. farm operators .883

Aggregate U. S. full-time farm operators .870

Aggregate U. S. part-time farm operators .916

Marginal propensities to consume (MPC) were:

MPC

Aggregate U. S. farm operators .406

Aggregate U. S. full-time farm operators .326

Aggregate U. S. part-time farm operators .618

Income elasticities for consumption (IEC) were:

IEC

Aggregate U. S. farm operators .406

Aggregate U. S. full-time farm operators .375

Aggregate U. S. part-time farm operators .675

The multipliers $\frac{1}{(1 - MPC)}$ were:

$\frac{1}{(1 - MPC)}$

Aggregate U. S. farm operators 1.68

Aggregate U. S. full-time farm operators 1.48

Aggregate U. S. part-time farm operators 2.62

Probabilities of consumption expenditures by U. S. full-time and U. S. part-time farm operators (Tables 8 and 9) revealed very limited debt repayment capacities for farm operators with annual disposable incomes of less than \$6,000. The basic assumption was that all annual savings generated by the farm operators were available for debt retirement.¹²

Capital formation. Aggregate positive savings generated in the U. S. agricultural sector in 1961 were estimated at \$2.90 billion, of which an estimated \$1.16 billion were consumed by dissavings. An estimated 53.6 percent of U. S. farm operators dissaved the \$1.16 billion dollars, which represented 40 percent of the aggregate positive savings generated. The dissavings occurred in income strata generating less than \$4,000 disposable income.

Poverty sector. Assuming that a disposable income level less than \$3,000 constitutes poverty in the U. S. agricultural sector, about 40 percent of all U. S. farm operators were in poverty in 1961.

¹²In addition to savings, the value of the 12-month flow of services, i.e., depreciation, is also available for debt retirement in the short run. However, in the long run, depreciation is equal to cost of the investment.

Conclusions

The difference between the average consumption expenditures of full-time and part-time farm operators in 1961 was not statistically significant. However, the consumption expenditure of full-time farm operators had a significantly greater variance than that for part-time farm operators. Full-time farm operators' consumption at low levels of disposable income was considerably higher than that for part-time farm operators. However, the marginal propensity to consume for full-time farm operators was much lower than that for part-time farm operators. Conversely, the marginal propensity to save for full-time farm operators was much higher than that for part-time farm operators. These behavior patterns were consistent with previous findings. The more risk and uncertainty associated with a group of entrepreneurs, the greater the percent of income saved by that group.

The probability estimates for an individual farm operator's consumption expenditures (Tables 8 and 9) revealed that as disposable income increased, consumption expenditures likewise increased and the percentage of farm operator families with consumption expenditures in excess of their disposable income declined. For each income stratum, a great dispersion of consumption expenditures existed among families of individual farm operators.

Although there was a positive association between disposable income and debt repayment capacity, disposable income was only a necessary condition, not a sufficient condition. Debt repayment capacity existed only when consumption expenditures were less than disposable income. Consequently, the sufficient condition was that aggregate consumption expenditures were less than disposable income. For example, at a disposable income level of \$8,500 for part-time farm operators in 1961, about 31 percent had consumption expenditures which exceeded their disposable income (Table 9). These farm operators had no debt repayment capacity.

There were U. S. farm operators in 1961 who had a combination of disposable income and consumption patterns which placed them in a favorable position for obtaining agricultural credit. But there also were many farm operators who had a combination of disposable income and consumption patterns which eliminated them from the agricultural credit feasibility group.

With probabilities of consumption expenditures for various income levels, lenders of agricultural credit may use this knowledge as a guideline for investigation activities concerning the credit worthiness of the applicant. These investigation activities may be minimized by estimating the applicant's disposable and depreciation income by using data from IRS

Forms 1040 and 1040F. The disposable income measurement (Y) for a given year may be obtained by subtracting the total federal tax liability from the taxable income measurement. The estimate for savings (S) may be measured by computing the change in net worth over a 12-month time period. Given the disposable income estimate (Y) and savings (S), the consumption measurement may be derived as follows: $C = Y - S$.¹⁸

With 3 years of observations for an individual farm operator, the lender of agricultural credit is in a strong position to evaluate the applicant. These observations typically may be obtained by a lender at a minimum of cost. This procedure provides the lender with a reliable estimate for consumption (C).

As it is necessary for lenders of agricultural credit to evaluate each individual loan applicant, the labor resources necessary for lenders to estimate debt repayment capacity for individual farm operators may be drastically curtailed by using this criterion.

¹⁸Information on an individual farm operator's IRS Forms 1040 and 1040F is confidential and may only be obtained voluntarily from the farm operator. Lenders of agricultural credit who have adopted this practice report no difficulty in securing the information.

BIBLIOGRAPHY

1. Brady, Dorothy S. and Rose W. Friedman. 1947. Savings and the Income Distribution. In *Studies in Income and Wealth*, X. National Bureau of Economic Research, New York, pp. 247-265.
2. Duesenberry, James S. 1952. *Income, Saving and the Theory of Consumer Behavior*. Harvard University Press, Cambridge, Mass.
3. Friedman, Milton. 1957. *A Theory of the Consumption Function*. Study by the National Bureau of Economic Research, Princeton University Press, Princeton, N. J.
4. Keynes, J. M. 1936. *The General Theory of Employment, Interest and Money*. Harcourt, Brace and Co., New York and London.
5. Kuznets, Simon. 1952. Proportion of Capital Formation to National Product. *American Economic Review*. Papers and Proceedings, XLII, pp. 507-526.
6. Lipsey, Richard G. and Peter O. Steiner. 1966. *Economics*. Harper and Row, New York.
7. Morgan, James N. 1951. The Structure of Aggregate Personal Savings. *Journal of Political Economy*, LIX: 528-534.
8. Reid, Margaret G. 1952. Effect of Income Concept Upon Expenditure Curves of Farm Families. In *Studies in Income and Wealth*, XV. National Bur. Econ. Research, New York, pp. 133-174.
9. Stigler, George J. 1954. The Early History of Empirical Studies of Consumer Behavior. *Journal of Political Economy*, LXII: 95-113.
10. U. S. Dept. of Agriculture. *Farm Income Situation*. Economic Research Service, FIS-207.
11. Williams, Faith M. and Carle C. Timmerman. 1953. *Studies of Family Living in the United States and Other Countries*. U. S. Dept. of Agriculture, Misc. Pub. 223.

APPENDIX

TABLE I.—Relation Between Consumption and Income for Farm and Non-farm Consumer Units, 1935-36, 1941, and 1948-50.

Group and Year	APC*	IEC†	MPC‡
Money Income and Consumption			
Non-farm or Urban**			
1. Families, 1935-36	.88	.82	.73
2. Families, 1941	.91	.87	.79
3. Spending units, 1948-50	.94	—	—
Farm			
4. Families, 1935-36	.80	.63	.50
5. Families, 1941	.75	.64	.48
6. Spending units, 1948-50	.88	.69	.61
Money Plus Non-money Income and Consumption			
Non-farm or Urban Families**			
7. 1935-36	.89	—	—
8. 1941	.92	—	—
Farm Families			
9. 1935-36	.87	.65	.57
10. 1941	.83	.69	.57

*Average propensity to consume. Ratio of arithmetic mean consumption to arithmetic mean income. For 1948-50, mean income is disposable income after personal taxes.

†Income elasticity of consumption. Slope of graphically fitted straight line regression of logarithm of consumption on logarithm of income.

‡Average propensity times elasticity.

**Non-farm in 1935-36 and 1948-50, urban in 1941.

Source: Friedman, Milton. 1957. A Theory of the Consumption Function. Study by the National Bureau of Economic Research, Princeton University Press, Princeton, N.J., pp. 62-63.

TABLE II.—Sample Size, Estimated Consumption Mean, Standard Deviation, and Standard Error of Mean by U. S. Full-time Farm Operators and Part-time Farm Operators, 1961.

Sample* Identity	† n	‡ $\frac{\Delta}{C}$	** $\frac{\Delta}{\sigma}$	†† $\frac{\Delta}{\sigma C}$
Y ₁	1306	\$4003.925	\$2510.690	\$ 69.394
Y ₂	489	4274.303	2509.446	113.365

* Y₁ = Full-time farm operators.

Y₂ = Part-time farm operators.

† n = Sample size.

‡ $\frac{\Delta}{C}$ = Estimated consumption mean in 1961 dollars.

** $\frac{\Delta}{\sigma}$ = Estimated standard deviation of the sample in 1961 dollars.

†† $\frac{\Delta}{\sigma C}$ = Estimated standard error of the consumption mean in 1961 dollars.

Source: U. S. Dept. of Agriculture. Consumer Expenditure and Income Survey, Rural Farm Population, United States, 1961.

TABLE III.—Statistics for Consumption Functions for Average U. S. Full-time and Part-time Farm Operators, 1961.

$$(4) \text{ Model: } \bar{C} = b_{0_e} + b_{1_e} Y + u$$

Symbols*	Full-Time Farm Operators	Part-Time Farm Operators
n	1306	489
b_{0_e}	2503.3018	1390.310
b_{1_e}	.3260	.6182
σ_{b_1}	.0118	.0205
σ_Y	4671.685	3278.491
σ_C	2510.699	2509.446
\bar{Y}	4603.531	4665.139
\bar{C}	4003.925	4274.309
r^2	36.80	65.23
$S_{e.y}$	1996.683	1481.223

* n = Number of observations in sample.

b_{0_e} = Level of consumption function.

b_{1_e} = Slope of consumption function (MPC).

σ_{b_1} = Standard error of MPC.

σ_Y = Standard deviation of disposable income, Y.

σ_C = Standard deviation of consumption expenditures, C.

\bar{Y} = Mean of disposable income.

\bar{C} = Mean of consumption expenditures.

r^2 = Coefficient of determination in percent.

$S_{e.y}$ = Standard error of estimate.

Source: U. S. Dept. of Agriculture. Consumer Expenditure and Income Survey, Rural Farm Population, United States, 1961.

TABLE IV.—Consumption Functions by Income Strata, U. S. Full-time Farm Operators, 1961.

$$(9) \text{ Model: } C_i = b_{0_{e_i}} + b_{1_{e_i}} Y + u$$

Statistical Symbols*	< \$1000	1000 to 1999	2000 to 2999	3000 to 3999	4000 to 4999	5000 to 5999	6000 to 7499	7500 to 9999	10,000 to 14,999	> 15,000
n	129	197	226	175	145	103	116	107	72	36
b_{0_e}	2324	1009	1840	1128**	1048**	—170**	—1312**	3144**	4482**	7692
b_{1_e}	— .45	.74	.41†	.69	.73†	.87†	.97	.31†	.24†	.10†
$\sigma_{b_{1_e}}$	.05	.26	.31	.33	.51	.54	.33	.26	.23	.08
\bar{Y}	—354	1516	2482	3487	5430	5460	6723	8554	11,942	22,605
\bar{C}	2484	2136	2851	3551	4365	4579	5208	5833	7383	9937
σ_Y	3229	290	273	284	287	291	466	728	1408	8882
σ_C	2441	1091	1266	1264	1754	1613	1691	1930	2750	4250
r^2	35.99	.39	.77‡	2.43	1.44‡	2.46‡	7.14	1.41‡	1.55‡	4.31‡
$S_{e,y}$	1960	1073	1264	1252	1748	1601	1636	1925	2748	4218

* n = Number of observations in sample.

b_{0_e} = Level of consumption functions.

b_{1_e} = Slope of consumption functions.

$\sigma_{b_{1_e}}$ = Standard error of MPC.

\bar{Y} = Mean disposable income, Y.

\bar{C} = Mean consumption expenditures, C.

σ_Y = Standard deviation of disposable income, Y.

σ_C = Standard deviation of consumption expenditures, C.

r^2 = Coefficient of determination in percent.

$S_{e,y}$ = Standard error of estimate.

† $H_0: b_{1_e} = 0$ The MPC is not significantly different from zero at the 5 percent level of significance..

‡ $H_0: r^2 = 0$ r^2 is not significantly different from zero at the 5 percent level of significance.

** $H_0: b_{0_e} = 0$ Level of consumption function is not significantly different from zero at the 5 percent level of significance.

Source: U. S. Dept. of Agriculture. Consumer Expenditure and Income Survey, Rural Farm Population, United States, 1961.

TABLE V.—Statistics for Consumption Functions by Income Strata, U. S. Part-time Farm Operators, 1961.

$$(9) \text{ Model: } C_i = b_{0_{e_i}} + b_{1_{e_i}} Y + u$$

Statistical Symbols*	< \$1000	1000 to 1999	2000 to 2999	3000 to 3999	4000 to 4999	5000 to 5999	6000 to 7499	7500 to 9999	10,000 to 14,999	≥ 15,000
n	32	76	57	70	59	55	70	38	25	7
$b_{0_{e_i}}$	1872	1090	—1024**	2689	2140**	2563**	1408**	4811**	141**	14,246**
$b_{1_{e_i}}$	— .83	.57	1.42	.19†	.48†	.44†	.67†	.33†	.78	— .31†
$\sigma_{b_{1_{e_i}}}$	.31	.28	.32	.31	.43	.55	.43	.55	.32	.55
\bar{Y}	398	1503	2481	3442	4562	5487	6567	8536	11,580	18,210
\bar{C}_i	1542	1947	2509	3346	4320	4989	5832	7589	9196	8545
σ_Y	764	291	315	302	296	280	410	546	1401	3431
σ_C	1434	720	874	763	963	1132	1495	1802	2416	4331
r^2	19.49	5.31	26.42	0.57‡	2.16‡	1.19‡	3.41‡	0.97‡	20.56	6.15‡
$S_{e.Y}$	1308	706	756	766	961	1136	1480	1818	2200	4596

* n = Number of observations in sample.

C = Consumption.

$b_{0_{e_i}}$ = Level of consumption function in stratum i.

$b_{1_{e_i}}$ = Slope of consumption function in stratum i.

$\sigma_{b_{1_{e_i}}}$ = Standard error for MPC in stratum i.

\bar{Y} = Mean disposable income, Y.

\bar{C}_i = Mean consumption expenditures in stratum i.

σ_Y = Standard deviation of disposable income, Y.

σ_C = Standard deviation of consumption expenditures.

r^2 = Coefficient of determination in percent.

$S_{e.Y}$ = Standard error of estimate.

† $H_0: b_{1_{e_i}} = 0$ The MPC is not significantly different from zero at the 5 percent level of significance.

‡ $H_0: r^2 = 0$ r^2 is not significantly different from zero at the 5 percent level of significance.

** $H_0: b_{0_{e_i}} = 0$ The level of the consumption function is not significantly different from zero at the 5 percent level of significance.

Source: U. S. Dept. of Agriculture. Consumer Expenditure and Income Survey, Rural Farm Population, United States, 1961.

TABLE VI.—Standard Errors of Forecast at Mean Disposable Income by Income Strata, U. S. Full-time Farm Operators, 1961.

Income Strata	\bar{Y}^*	$S_{e.y}^\dagger$	$\sqrt{1 + \frac{1}{n}}^\ddagger$	ΔS_F^\ddagger	
< \$ 1,000	—354	1960	1.01550480	1990.38940800	(Open End Class)
1,000 - 1,999	1516	1073	1.00655744	1080.03613312	
2,000 - 2,999	2482	1264	1.00873379	1275.03951056	
3,000 - 3,999	3487	1252	1.00711752	1260.91113504	
4,000 - 4,999	4530	1748	1.00843896	1762.75130208	
5,000 - 5,999	5460	1601	1.00904995	1615.48896995	
6,000 - 7,499	6723	1636	1.00711752	1647.64426272	
7,500 - 9,999	8554	1925	1.01307245	1950.16446625	
10,000 - 14,999	11942	2748	1.18321595	3251.47743060	
≥ 15,000	22605	4218	1.06944940	4510.93756920	(Open End Class)

* \bar{Y} = Mean disposable income for stratum i.

† $S_{e.y}$ = Standard error of estimate for stratum i.

‡ $\sqrt{1 + \frac{1}{n}}$ = Component of the standard error of forecast equation, i.e.

$$\Delta S_F = S_{e.y} \sqrt{1 + \frac{1}{n} + \frac{(Y_0 - \bar{Y})^2}{\sum y^2}}$$

n = Sample size.

1 = Error of individual observation.

$\frac{1}{n}$ = Error due to mean or level.

Source: Appendix Table IV.

TABLE VII.—Standard Errors of Forecast at Mean Disposable Income by Income Strata, U. S. Part-time Farm Operators, 1961.

Income Strata	$\frac{*}{Y}$	$S_{e.y}^{\dagger}$	$\sqrt{1 + \frac{1}{n}}^{\ddagger}$	$\Delta_{S_x}^{\ddagger}$	
\$ 1,000	398	1308	1.00386848	1313.05997184	(Open End Class)
1,000 - 1,999	1503	706	1.00253485	707.78960410	
2,000 - 2,999	2481	756	1.00220994	757.67071464	
3,000 - 3,999	3442	766	1.00285307	768.18545162	
4,000 - 4,999	4562	961	1.00344235	964.30809835	
5,000 - 5,999	5487	1136	1.00484264	1141.50123904	
6,000 - 7,499	6567	1480	1.00430109	1486.36561320	
7,500 - 9,999	8536	1818	1.00466202	1826.47555236	
10,000 - 14,999	11580	2200	1.00692049	2215.22507800	
\geq 15,000	18210	4597	1.00137938	4603.3409868	(Open End Class)

* \bar{Y} = Mean disposable income for stratum i.

\dagger $S_{e.y}$ = Standard error of estimate for stratum i.

\ddagger $\sqrt{1 + \frac{1}{n}}$ = Component of the standard error of forecast equation, i.e.

$$\Delta_{S_x} = S_{e.y} \sqrt{1 + \frac{1}{n} + \frac{(Y_0 - \bar{Y})^2}{\sum y^2}}$$

n = Sample size.

1 = Error of individual observation.

$\frac{1}{n}$ = Error due to mean or level.

Source: Appendix Table V.

The State Is the Campus for Agricultural Research and Development



Ohio's major soil types and climatic conditions are represented at the Research Center's 11 locations. Thus, Center scientists can make field tests under conditions similar to those encountered by Ohio farmers.

Research is conducted by 13 departments on more than 6200 acres at Center headquarters in Wooster, nine branches, and The Ohio State University.

Center Headquarters, Wooster, Wayne County: 1953 acres

Eastern Ohio Resource Development Center, Caldwell, Noble County: 2053 acres

Jackson Branch, Jackson, Jackson County: 344 acres

Mahoning County Farm, Canfield: 275 acres

Muck Crops Branch, Willard, Huron County: 15 acres

North Central Branch, Vickery, Erie County: 335 acres

Northwestern Branch, Hoytville, Wood County: 247 acres

Southeastern Branch, Carpenter, Meigs County: 330 acres

Southern Branch, Ripley, Brown County: 275 acres

Western Branch, South Charleston, Clark County: 428 acres